A survey of Indo-Japanese Trade focussing on the environmental considerations in select industries

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1 Introduction

The inter-relationships between trade and environment have become a topic of considerable debate in the recent years. One reason is that world trade is growing at a fast rate. Merchandise trade (including both primary commodities and manufactured products) has grown eleven-fold since 1950 while, in comparison, global economic output grew only five-fold over this period. Trade in services is also on the rise, as is the level of foreign direct investment. Further, in the coming years, trade liberalization and opening up of the markets of developed and developing countries alike are expected to boost world trade by US$200 billion per year. Moreover, the market for 'environmental goods' is estimated to grow from its current US$300 billion to $600 billion by 2000 AD (Bharucha, 1994). Another reason for the urgency to address this issue stems from governments aggressively pursuing trade-expansionary policies through a number of ongoing and recently concluded trade/environmental negotiations namely, multilateral environmental agreements (MEAs) and multilateral trade agreements (MTAs).

In the debate over trade and the environment, there are those who have emphasized the threats to the environment posed by growing world trade, and those who have stressed above all else its benefits. In fact, trade is neither inherently good nor inherently bad for the environment but could, in fact, be either. By encouraging its benefits while working towards minimizing its costs, governments can make trade a partner rather than an obstacle in the worldwide quest for an ecologically sustainable development path.

In fact, in a recent paper, OECD* has declared: *Trade and environment policies should be seen as being mutually supportive rather than in terms of conflicting interests. Trade spurs economic growth and helps provides the technical and financial resources to protect the environment, while a healthy environment provides ecological and natural resources needed to underpin long-run growth stimulated by trade. ...it is therefore important that trade policies are sensitive to environmental concerns and that environmental policies take account of effects on trade. Unlike sustainable development, free-trade is not an end in itself... (OECD, 1991).*

Literature survey

Although the relationship between trade and environment is a relatively new research theme, a great deal of debate has raged on the effects of international trade and trade liberalization on the environment.

* Organization for Economic Cooperation and Development.

Since the beginning of the 1970s, efforts have been made to investigate the link between international trade, environmental quality and pollution, both at theoretical and empirical levels. There have been attempts to study the impact of trade policies on environment, as well as the implications of environment policy on the pattern and direction of trade. Early contributions were those of Baumol (1970), GATT (1971), Siebert (1973, 1974), Markusen (1975), and Walter (1975, 1976). Recently, increasing attention has been directed to trade and environment linkages. In particular, see Anderson and Blackhurst (1992), Low (1992), Ekins *et al.* (1994), van Ierland (1994), and Carraro (1994). Whalley (1991) gives a succinct introduction to some of the issues involved, while Dean (1992), de Boer (1994), van Beers and van den Bergh (1996), and Beghin *et al.* (forthcoming) provide an interesting survey of the literature. Also, the UNCTAD secretariat has come out with a number of excellent reports on trade, environment and development (especially TD/B/WG.6/6, TD/B/WG.6/9 and TD/B/WG.6/10). The report of the Committee on Trade and Environment (CTE) was adopted as the annexure to the World Trade Organization's (WTO's) Ministerial Conference, held in Singapore in December 1996. These studies not only indicate that international trade has implications for the environment, primarily by altering the volume and international location of production and consumption but also point to the fact that trade and the environment are heavily tied up with environmental policy.

Trade protagonists and GATT* (1992) recognize the fact that there is a serious threat of environmental issues being exploited as protectionists measures. In its special publication titled *Trade and Environment* (GATT, 1992), it also recognizes the following principles:

- Environmental goods have a high income elasticity, that is, as income grows, the average citizen will be more willing to offer resources for improving the environment.
- Productive and efficient technologies that are less environmentally damaging are developed in countries with stricter environmental regulations, and trade is a good way to diffuse these technologies.
- Free trade gives the consumer the greatest opportunity to choose 'green' products.
- Multi-lateral co-operation is necessary to solve several environmental problems, and free trade establishes the best climate for such co-operation.

It opines that: *First there is a need to place much greater emphasis on assigning values or prices to environmental resources, with a view to identifying and valuing the environmental effects of economic activity. Second is the idea that each generation should pass on to the next at least as much capital - environmental and man-made - as it inherited.*

* General Agreement on Tariffs and Trade.

Neither aspect of sustainable development is intrinsically linked to international trade. A failure to place a value on environmental resources would undermine sustainable development even in a completely closed economy. Trade is seen, rather, as a 'magnifier'. If the policies necessary for sustainable development are in place, trade promotes development that is sustainable (GATT, 1992).

In other words, environmental externalities should be internalised, so that trade can take place on the basis of prices that reflect the true social costs, the so-called 'first best policy'. The same view is expressed in *The Greening of World Trade Issues*. Summarising the conclusions of the studies in the book, Anderson and Blackhurst write: *The impact of trade and trade liberalisation on a country's overall welfare depends on whether the country's environmental resources are correctly priced. ... If they are, trade and trade liberalisation benefit the environment because the resulting increase in economic growth stimulates the demand for environmental protection and generates additional income to pay for it today (Anderson and Blackhurst, 1992).*

A commonly offered argument is that a country which imposes more stringent environmental regulations than the other, is expected to experience a deterioration in its comparative advantage in trade in pollution intensive goods. Countries that impose stricter environmental policies, pollution intensive industries either experience a loss of competitiveness or try to avoid the rise in production costs by migrating to areas where these policies are more loose or non-existent. Both these situations will be reflected in reduced exports of the pollution intensive commodities. Furthermore, as domestic consumers will substitute foreign products for domestic ones, imports are expected to rise. So far, empirical work does not strongly support this hypothesis*.

On the other hand, Porter (1991) has argued that governments could provide a competitive advantage to their domestic producers by imposing environmental policies which are tougher than those faced by their rivals, since this will spur industries to innovate greener technologies ahead of their rivals, and enhance the long run profitability of their domestic industry. In the initial stages, governments may even subsidize investment in greener technologies to encourage faster adoptions.

To study the effects of environmental policy on international competitiveness (and vice versa) it is essential to take into account the scale on which the environmental problems occur, the structure of the market (both export and import), and the quantum of trade.

* An OECD study (OECD, 1985a & b) found that for some OECD-countries, adopting anti-pollution poli resulted in a small reduction of exports. Low (1992) has also pointed out that environmental costs are n serious burden on the respective industries, so that competitiveness is hardly influenced by a strict envi policy.

North-South conflict

The ability of developing countries to implement environmental norms is limited by financial and technical constraints, for it has more imminent problems of economic growth, development and social welfare to worry about. Therefore, the need to comply with specific external environmental policies may divert funds from investments which not only yield economic growth and development, but as some argue, would yield higher environmental benefits. Besides, the immediate domestic demand in the developing countries for 'green' products is almost non-existent. So the competitiveness of the product also gets affected in terms of the price, making them unviable and unproductive. On the other hand, the evolving diverse international product standards (at times country specific standards), and the various MEAs (e.g. Basel Convention, CITES, Montreal Protocol, etc.) make it imperative for the developing country to take cognizance of these environmental norms in their commodities and commodity production, making trade and environment a hard reality.

In the developed countries, discussions have primarily addressed the question of whether competitiveness concerns (that is, a concern that trade or investment may be lost to countries which have less stringent environmental standards) may discourage the implementation of more stringent domestic environmental requirements. But, ... *evidence does not show that competitiveness has been adversely affected (UNCTAD, 1995b).*

In this debate on trade and environment, the concerns of developing countries have centred around the following issues. Trade policy in developed countries affects the quality and use of natural resources in developing countries. The existence of high import tariffs on processed products, set by the developed countries, results in greater dependency of developing countries on the export of raw materials and primary products. This in turn, together with international debt problems and a fast growing population, leads to environmental damage and excess extraction of natural resources.

Further, in this case, the question regarding specific environmental standards, particularly those arising from external markets adversely affecting the export competitiveness of the domestic (developing) country becomes an important issue. In these cases, theoretically, the environmental regulatory measure could be so narrow and specific that it may actually recommend a particular technology or production process. Also, the incremental costs required to affirm to these international standards may render the production of these commodities unviable. This is because most of the developing countries have had a high concentration of exports on a relatively small number of products/sectors based on their comparative advantage. Therefore, developing countries fear that gains arising from globalization/trade liberalization (following the Uruguay Round) for products from these sectors could be eroded if compliance with

environmental standards were to lead to cost increases or discrimination against their exports (UNCTAD, 1995b).

Environmental policies and consumer concerns in the developed countries are to a large extent sector specific, affecting such sectors as fishery and forestry products, leather and footwear, textiles and clothing, and certain consumer products. A number of product requirements such as bans on the use of specific chemicals, packaging regulations and eco-labeling apply to these sectors (and at times could be so narrow as to recommend particular process requirements). As these sectors account for a significant share of total exports of developing countries, environmental policies could potentially affect not only export competitiveness but also export promotion strategies. This aspect may be particularly relevant for Asian developing countries since a large share of their exports, in value terms originates in such sectors. (UNCTAD, 1995b)

As one would expect, the competitiveness effects of external environmental regulations are more likely to be significant for small and medium-sized enterprises (SMEs) and for firms in specific sectors which have lower technological and financial capability to cope with the changing regime. Not only does the share of SMEs in total exports of developing countries vary widely, they also export only a small share of their total output. This implies that potential to expand SME exports is very large for the developing countries, where SMEs are indeed important players in the export promotion strategies. This is an important area of concern for developing countries with respect to trade and environment linkages.

According to an ITC* survey, SMEs' share was around 50% of total exports in a number of developing countries. The share of the SMEs in India's total exports was put at about 32%. In Bangladesh, SMEs account for nearly 80% of their exports, which is a mere 4% of their total output. (UNCTAD, 1995b).

Scope and coverage of the study

For a country whose exports comprise a majority of environmental sensitive goods, the impact of environmental regulation - both domestic as well as external - on the production and trade in such goods has a significant bearing. This is especially so if the exports originate from the SMEs in a developing country, as has been argued above.

In India, two of the most important export oriented SMEs have historically been the marines and the leather (and leather manufactures) sector. In fact, fisheries and leather and leather products alone accounted for nearly 10% of exports in 1995/96 as well as in 1996/97. These sectors also account for nearly 1% of India's GDP. This contribution assumes significance especially when one considers that in both 1995/96 and 1996/97, overall exports of the country

* International Trade Centre, Geneva.

account for nearly 10.5 % of the nation's GDP. A bulk of these exports have been absorbed by the OECD countries, in particular Japan for fish and fish products and Germany for leather goods. In fact, Indian exports of marine products account for more than 40% of Japanese imports of marine products. This was the case in 1995/96 as well as in 1996/97. Further, historically, Japanese imports of marines have been nearly 0.3% of their GDP.

It is these very goods which have now to adhere to environmental norms (including health related standards) and policies due to a spate of environmental regulations instituted in the last decade or so. The new environment policies have been brought into force not only by the Government of India, but also the major trading partners. For instance, in case of marine products, the presence of cholera bacteria in Indian consignments had threatened seafood exports. Similarly, being entirely resource based, the threat to sustainability of marine stocks has come up as a matter of concern time and again. Recent governmental bans on aquaculture and deep-sea fishing have put a new set of constraints on the fish exporters.

In 1991 the German Customs officials disallowed entry of Indian leather products into their country on the ground that these were contaminated by pentachlorophenol (PCP), a toxic fungicide. Consequently the Indian tanners was forced to adapt their tanning process to comply with the new PCP threshold of 5ppm as per German standards. Similarly, the use of formaldehyde and benzidine containing dyes and many other solvents is also restricted, and the use of ecofriendly chemicals has become mandatory.

Estimates of cost of complying with these environmental regulations or their direct impacts are often hard to obtain since they vary considerably between different products and export markets. Estimates of effluent treatment costs in the seafood processing units is found to be less than 2-3% of annual sales turnover. For leather and textiles, increases in the range of 3-5% in variable costs have been quoted by most exporters, while capital costs have been reported to be higher, at 10-15%. Other sources quote these to be much lower, in the range of 1-2% of unit sale value. Although, these costs appear to have a small to medium bearing, given India's export drive in the last two decades largely based on the above mentioned products and environmental standards getting stricter, the possible implications on the export and production capacities of these sectors are likely to be of consequence.

A study on selected sectors in India reports that while in some sectors such as fisheries, price premiums may be high enough to adapt to changes brought about by environmental considerations, in textiles and leather the possibilities of adjustments may be smaller on account of low-value addition and lower margins.

The purpose of this study is to analyze the effects of major environmental policies on the trading prospects of Indian exports as well as the effects of trade on the environment. Since the most vulnerable of Indian exports from the

environment point of view are those emanating from the SMEs, this study would focus on the Indian marine exports. As over 40% of these exports go to Japan, India being the number one marine exporter to Japan and Japan being the leading marine importer in the world, a case study of India's marine exports to Japan has been undertaken. In order to abstain from generalizing the case of the marine exports to Japan to typify the case of the SMEs in India, a similar analysis has also been attempted for India's exports of leather and leather manufactures to Germany, Germany being the leading market for these exports. Germany has also been chosen because not only is it typical of India's trade with the EU (more than 25% of India's exports go to EU), but together with Japan it would iterate a study of India's trade with the OECD (accounting for nearly 55% of India's exports). Also Germany has some of the most stringent environmental policies in place.

The aim of this study is to see how Indian SME exporter's have responded to the challenge posed to them by the new 'environment-friendly' regime the world over. Often more stringent standards have been imposed by a particular state government and not the other. In case of such asymmetries, the process of complying with standards may have conferred a disadvantage on some exporters in comparison with their competitors in other states where regulation is non-existent or lax. Are there any such instances? Is it that units in the small and medium unorganized units in an industry would have confronted greater problem of adaptation and given way to larger organized units?

We seek to answer these and other related questions by means of a case study, based on the evidence and information collected from the affected parties. This part of the study addresses the issue in a qualitative manner. In addition, a quantitative, econometric exercise is also for carried out for marine exports, to Japan, to see what are the factors that have a bearing on the level of exports in the past. The focus here is on export flows of marine products to Japan alone, which is regressed on various economic and demographic variables as well as a dummy variable representing growth of environmental regulation with regard to the sector. We find that the response of the exporting units has been positive, governmental support (both technical and financial) has been forthcoming and the impact of environmental regulations has been transitory. As we shall see, the outcome of the regression analysis corroborates the qualitative assessment of the case study.

In terms of the layout of sections, the Chapter 2 of the report covers a discussion on the marine industry. It includes a background note on the marine industry in India in terms of the technology, production and export trends, gives an account of the emergence of environmental regulations and their effects and concludes with presentation of results of the regression analysis. The following Chapter 3 has a similar coverage for the leather and leather goods industry; on

account of paucity of adequate data we have not been able to attempt an econometric exercise for this sector's export performance. Chapter 4 contains the principal conclusions of the study. The data used for the econometric exercise is presented in Annexure to this report.

India

As mentioned earlier the extent to which the regulatory framework of the importing country, as also domestic environmental regulations, could influence a country's trade would depend on the quantum/value of trade in the affected or regulated sectors, the relative share of these traded commodities in the exporting country's overall trade, and the importance attached to the concerned destination market by the home country.

Marine products, leather and leather manufactures, textiles, agriculture (inclusive of prepared foodstuffs), precious, semi-precious stones and jewellery, and engineering goods constitute the primary export goods. Apart from the fact that these are polluting sectors, they have recently shown high growth rates and are also the source of major items of export to the OECD. An UNCTAD Report (1995b), *Environment, International Competitiveness and Development: Lessons from Empirical Studies*, in a preliminary analysis has shown that *one third of the value of total exports ... originate in sectors potentially affected by environmental requirements.*

The RBI Report on Currency and Finance, 1995/96 states that in 1995/96 the broad direction of Indian trade remains unchanged with the Organization for Economic Co-operation (OECD)[1] countries continuing to constitute both the principal market for Indian exports and a major supplier of imports into India. The figures for 1995/96 cited are provisional figures (RBI, 1997). The shares for India's four trading partners (exports and imports), for the same period were 54.0% of the OECD, 26.6% for developing countries, 14.3%for OPEC and 4.4% for Eastern Europe. The figures for exports to these major trading partners are OECD (55.6%), OPEC (9.6%), Eastern Europe (4.2%) and developing countries (28.9%). Amongst the OECD countries, EU garners a share of over 25%, USA of over 17% and Japan for over 7%, and Germany for over 6%. In fact, USA, Japan and Germany are top three leading export destination for Indian commodities.

India has comprehensive regime of environmental laws. Environmental laws play a crucial role in promoting environmentally responsible behavior. India is also amongst the first countries to incorporate protection of environment as one of the fundamental duties of every citizen in its constitution. Apart from specific environmental enactments, there are numerous provisions in many other enactments which tackle degradation of environment and industrial pollution.

[1] The OECD group includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and the United States.

The Ministry of Environment and Forest (MoEF) is the nodal agency at the central level for the formulation of policy, planning, promotion and coordination of environmental programs. A number of enforcement agencies assist the MoEF in executing the assigned responsibilities.

The importance of environmental legislation in protecting the environment was formally recognized in India after the promulgation of the Water (Prevention and Control of Pollution) Act, the first specific and comprehensive legislation in 1974. The Air (prevention and control of pollution) Act 1981 was likewise enacted to deal with air pollution. Thereafter the most significant umbrella legislation, the Environment (Protection) Act was enacted by parliament in 1986 for protection and improvement of the environment in its totality. These laws are supplemented by numerous implementing regulations periodically by federal as well as state governments. A listing of the most important environmental legislations in play in India is presented in Table 1.1 below.

Table 1.1 Environmental Legislation in India

Year	Environmental Legislation
1974	The Water (Prevention and Control of Pollution) Act
1975	The Water (Prevention and Control of Pollution) Rules
1977	The Water (Prevention and Control of Pollution) Cess Act
1978	The Water (Prevention and Control of Pollution) Cess Rules
1981	The Air (Prevention and Control of Pollution) Act
1982/1983	The Air (Prevention and Control of Pollution) Rules
1986	The Environment (Protection) Act
1986	The Environment (Protection) Rules
1988	National Forest Policy
1989	The Hazardous Wastes (Management and Handling) Rules
1989	Manufacture, Storage and Import of Hazardous Chemical Rules/Amendment Rules, 1994
1989	Manufacture, Use, Import, Export and Storage of Hazardous Micro Organisms, Genetically Engineered Micro-organisms or Cell Rules
1990	Involvement of Village Communities and Vas in the Regeneration of Degraded Forest Lands
1991	The Public Liability Insurance Act
1991	The Public Liability Insurance Rules
1992/1993	Environmental (Protection) Rules - "Environmental Statement"
1993	Environmental (Protection) Rules - "Environmental Standards"
1994	Environmental (Protection) Rules - "Environmental Clearance"
1995	The National Environment Tribunal Act
1995	Supreme Court Interim Judgement on Protection and Conservation of Forests

Japan*

The Basic Environment Law Bill, unanimously passed by the National Diet in its 128th Session on November 12, 1993, establishes the foundation of Japanese environmental laws and policies. This Law declares the principles of environment policy, defines the responsibilities of each sector of society, and prescribes the policy instruments to protect the domestic and global environment. The Basic Law was enacted to address all aspects of environmental problems including global environmental problems, urban pollution from daily life, loss of accessible natural environment, and even lessening environmental protection capacity for forests and farm land.

Before this, Japanese environmental policy was primarily based on: (i) The Basic Law for Environmental Pollution Control enacted in 1967 to combat the serious industrial pollution which affected Japan badly in the period of rapid economic growth of the late 1950s and 60s, and (ii) the Nature Conservation Law, enacted in 1972 to bring to end the destruction of outstanding features of the natural environment.

This Law is established on three basic principles of environmental policy:

- The blessings of the environment should be enjoyed by the present generation and succeeded to by future generations.
- A sustainable society should be created where environmental burdens created by human activities are minimized.
- Japan should contribute actively to global environmental conservation through international cooperation.

Further, the Law defines the responsibilities of each party in society, that is the State, local governments, corporations and the general public. These parties should make cooperative efforts to protect the environment through fair burden sharing.

Based on these principles and responsibilities, the Law stipulates the policy instruments of Japanese environmental policy. In addition to regulatory measures traditionally taken for pollution control and nature protection, the Law, above all, prescribes the following measures:

- Environmental consideration in policy formulation.
- Formulation of the Basic Environment Plan which sets out the outline of long-term environmental policy. This Plan was formulated on December 16, 1994.
- Environmental impact assessment for development projects.
- Economic measures to encourage activities for reduction of environmental burdens.

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*This section draws from: Government of Japan, 1997. Japan's Environmental Protection Policy 1997. Global Environment Department, Environment Agency.

- Improvement of social infrastructure such as sewerage systems, transportation systems, etc.
- Promotion of environmental activities by corporations, citizens and non-governmental organizations (NGOs) as well as environmental education and dissemination of information.
- Advancement of science and technology related to environmental protection.
- International cooperation for global environmental conservation.

In accordance with the provisions of the Basic Environment Law, in December 1994 the Japanese Government formulated the Basic Environment Plan outlining the overall, long-term policies of the Government for environmental conservation.

In order to tackle the environmental problems, the Basic Environment Plan sets long-term objectives for environmental policy through to the middle of the 21st century. It also provides the basis for government policies in the period of the early 21st century and sets out expectations for activities to be carried out by local governments, private corporations, non-governmental organizations, and citizens in order to achieve their objectives. In particular it specifies the role of each sector of society and appropriate instruments for policy implementation. At present, the Environment Agency and other ministries concerned are implementing specific measures for environmental conservation under this plan. Local governments, corporations, private citizens, and other parties in society are also voluntarily and actively engaged in environmental protection activities under the Plan. The long term objectives of this plan are:

Second material cycle

In order to minimize burdens on the environmental generated at various stages of socio-economic activities, the Plan calls for a socio-economic system fostering environmentally-sound cycling of substances through re-examining the current system dominated by mass production, mass consumption and mass disposal.

Harmonious coexistence

With a view to ensuring that the blessings of the environment may be enjoyed by both present and future generations, the Plan requires the maintenance or restoration of sound ecosystems while ensuring harmonious coexistence between nature and human beings.

Participation

To build up a society where all parties, including the national government, local governments, corporations, individual citizens, and private organizations participate voluntarily and actively in environmental conservation activities while cooperating with each other and sharing responsibility in a fair manner.

International activities

With the aim of promoting environmental conservation efforts across national boundaries, the Plan calls for cooperation with all other countries sharing the common goal of conserving the global environment.

As seen from above, the Japanese have been at the forefront in tackling issues arising out of environmental consideration. With specific reference to the marine products sector, their policy (though not as stringent as that of, say, EU) states: marine pollution by oil and hazardous wastes is affecting the marine ecosystems, resulting in the death of water birds and turtles due to accumulation of toxic substances and intake of plastics. Japan is in full agreement with the London Convention and the MARPOL 73/ 78 for the prevention of marine pollution. In October 1995, Japan ratified the OPRC Convention adopted in 1990.

2 Marine industry

Growth of the Indian marine sector

India is endowed with substantial resources of marine and inland fishery resources, by virtue of which it is the seventh largest producer of fish and fishery products in the world and a major exporter of the commodity. Fish production and processing have harmful effects on the environment. The environmental concerns in this sector are distinct from those which arise in conventional manufacturing sectors; they are associated with unsustainable harvesting of the resource stocks. Being an edible commodity, this sector is also important from the 'health' aspect. A large number of norms and regulations in this sector (both external as well as domestic) stem from this concern.

As for India's marine resources, it has a long coastline of 8129 km with a continental shelf of over 500 thousand sq. kms, concentrated mainly in states of Gujarat, Maharashtra, Karnataka and Kerala in the west and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal in the east. Of the total potential, only 58% lies in the depth range of 0-50 kms, another 35% in 50-200 kms and less than 10% in depth range beyond it (see Table 2.1 for details); of this, the actual exploitation so far has been mainly concentrated in lower depth ranges. There are 3638 fishing villages in India and the catch lands at 2251 traditional landing centres.

Table 2.1 Potential resources and level of exploitation **(million tonnes)** in the Indian Exclusive Economic Zone (EEZ)

Depth range (metres)	*0-50*	*50-200*	*200-500*	*Oceanic*	*Total*
Demersal	1.28	0.625	0.028	_	1.933
Neretic Pelagic	1.00	0.742	_	_	1.742
Oceanic Pelagic	_	_	_	0.246	0.246
Total	2.28	1.367 (35%)	0.028	0.246	3.921
	(58%)		(0.7%)	(6.3%)	(100%)
Level of exploitation	2.08	0.63	..	..	2.71
Available for exploitation	0.20	0.737	0.028	0.246	1.211

Source. GoI, 1996.

The inland water resources of India comprise three categories - riverine systems (including canals) of around 171 thousand kms in length, reservoirs of around 2.05 million hectares, lakes and ponds covering 2.85 million hectares and beels, oxbow and derelict water of around 0.8 million hectares. In addition, an

area of another 1.19 million hectares has been identified for brakishwater aquaculture, of which a mere 11% is developed into shrimp farms.

The Plan Government Outlay (which includes Central, Centrally Sponsored and State schemes) for fishery development grew over 200 times, from modest Rs 51.3 million in First Plan Period (1951-55) to Rs 12328.2 million in the Eighth Plan (1992-97). The main features of the development of fisheries during the Plan periods included enlargement of mechanized fishing fleet, motorization of traditional crafts (wherever possible) and introduction of new types of boats. The use of synthetic fiber was also encouraged followed by use of indigenous material for fabrication of fishing gear and bottom trawling in addition to commercial fishing methods. Deep-sea fishing and aquaculture received major attention during Fourth and Fifth Plans and a fresh impetus in the subsequent Plan periods.

Consequent to these developments, the Indian fisheries sector today comprises 6 major and 27 minor fishing harbors and 109 improved landing centers. A substantial growth can also be observed in the fishing fleet of mechanized crafts from 7,000 in the 1960s to 47,000 in 1996, with an addition of about 180 large fishing vessels. The fleet of non-mechanized (including motorized) crafts grew from a modest 91 thousand to 191 thousand over the same period. An associated uptrend can be seen in the number of auxiliary small scale units in the fish processing sector in the country. There exist a total of 372 freezing plants with 6600 tonnes/day capacity, 14 canning plants with 52.5 tonnes/day, 148 ice making plants with 1800 tonnes/day capacity, 15 fishmeal units of 330 tonnes/day capacity, 450 cold storage plants with over 80,000 and 900 peeling sheds with a daily capacity of over 2500 tonnes; all these are predominantly export oriented.

The employment in production and processing sectors grew from 0.6 million to 1.025 million over the period 1980/81 to 1994/95. The contribution of fisheries (marine and inland) to the net domestic product increased eight folds during 1980/81 to 1993/94, while from agricultural sector the increase was around four folds.

Following is a summary of major developments in different Plan periods. It explain the steady increase in the productivity of the sector, as also the associated emergence of environmental concerns in the sector.

Table 2.2 Thrust areas for plan development in Indian marine fisheries

Plan period	*Major developments*	*Average annual catch (million tonnes/year)/culture production (tonnes)/year*
First (1951-55)	Exploratory surveys	0.56
	Mechanization of indigenous artisanal fishing craft	
Second (1956-60)	Introduction of mechanized vessels	0.73
	Introduction of modern gear material	
	Infrastructure for preservation, storage and transportation	
Third (1961-65)	Substantial increase in use of synthetic gear material	0.73
Three annual plans (1966-68)	Export trade	0.70
Fourth (1969-73)	Imports of trawlers for deep-sea fishing	1.07
	Indigenous construction of deep-sea trawlers	
	Fishing harbors at major and minor ports	
	Expansion of export trade	
Fifth (1974-78)	Diversification and introduction of purse-seines	1.33
Annual plan (1979)	Diversification of products	1.37
	Motorization of artisanal craft	
Sixth (1980-84)	Intensification of exploratory surveys in offshore areas	1.43
	Declaration of the EEZ in 1977	
	Regulation of foreign fishing vessels	
	Deepsea fishing through licensing and chartering	
Seventh (1985-89)	New chartering policy of 1989	1.72
Two annual plans (1990-91)	Development of deepsea fishing through joint ventures	2.18
	Substantial growth in motorized artisanal fleet of ringseiners	
	Coastal shrimp aquaculture	
Eighth (1992-97)	Deepsea fishing by joint venture	2.23 (2.41 in 1996)/
	Development of coastal aquaculture	60,000-100,000
	Export trade changes from resource based to food-engineering based industry	

Source. CMFRI, 1997.

In recent years India's fish production (of marine and inland fish) has accounted for around 4.5% of the global production. Its position in the world shrimp production is also high, with a share at around 10% of the global output.

Although the production of fish could come from the wild (capture fisheries) or from coastal mariculture and sea farming, the recent trend is indicative of the rising importance of inland fish farming in overall fish production (Table 2.3). This latter category mainly comprises (1) capture fisheries from reverine systems, (2) stocking cum capture fisheries from reservoirs and (3) culture fish from ponds and tanks.

Table 2.3 Fish production from manne and inland sources (million tonnes)

Year	Manne	Inland	Total	Percent	
				Manne	Inland
1970/71	1.086	0.67	1.756	61.8	38.2
1980/81	1.555	0.887	2.442	63.7	36.3
1985/86	1.716	1.160	2.876	59.7	40.3
1990/91	2.3	1.536	3.836	60.0	40.0
1991/92	2.447	1.710	4.157	58.9	41.1
1992/93	2.576	1.789	4.365	59.0	41.0
1993/94	2.649	1.995	4.644	57.0	43.0
1994/95	2.692	2.097	4.789	56.2	43.8
1995/96	2.707	2.242	4.949	54.7	45.3
1996/97	2.967	2.381	5.348	55.5	44.5
1997/98(T)	2.943	2.42	5.363	54.9	45.1

Source. GoI, 1996.

Marine fisheries

Till 1940s, fishing in the Indian seas depended mainly on traditional artisanal gear and craft in the nearshore waters. The scenario has changed dramatically since then with popularization of mechanized fishing vessels using trawlers, motorization of traditional crafts and induction of deep-sea fishing vessels. As has been documented in Table 2.2, in the 1970s purse seines were also introduced along the South East coast. Greater availability of information on spatial distribution and abundance of fish stocks attracted additional investment in infrastructure, with consequent expansion of fishing areas and increase in production. The production of capture fisheries rose from a small base of around 0.6 million tonnes in 1950 to 2.36 in the Eighth Plan period (1992-97). In terms of shares, around 90% of the present production from marine sector originates from the 0-50/80 metres depth zones and the remaining 10% from the depth range of upto 200 metres. Additionally, while 96% of this is contributed by artisanal mechanized and motorized sectors, the remaining 4% is contributed by deep-sea fishing vessels. Of the total fish landing from marine sector, around 45% is the share of small and medium units which deploy artisanal boats, with the rest accounted for by mechanized fishing.

The relative stagnation or even a slight fall in the growth rate of annual catch in 1990s is on account of yields having reached an optimum level in the inshore fishing areas within a depth of 50 metres. The statistics in Tables 2.1 and 2.2 corroborate this.

As can be seen from the data in Table 2.4, the substantial increase in fishing effort has led to a decline in per capita area per fisherman and also the catch per unit effort. A natural outgrowth of such trends is rapid exploitation of fish stocks and an emergent conflict amongst different categories of fishermen, particularly

between artisanal and mechanized groups. The data clearly indicates the extent of decline in area per fisherman in the inshore and offshore areas in maritime States/Union Territories of India.

Table 2.4 Change in the availability of coastal area per active fisherman

State	1961/62	1973/77	1980	1990
Inshore coastal shelf (0-50 metres depth) (hectares/boat – mechanized + non-mechanized)				
Gujarat	1453	1095	862	499
Maharashtra	257	251	205	108
Goa	3030	229	87	94
Karnataka	114	109	89	51
Kerala	59	57	44	40
Tamil Nadu	78	74	52	53
Pondicherry	–	82	77	25
Andhra Pradesh	84	64	46	31
Orissa	528	317	147	96
West Bengal	1503	599	234	192
Offshore coastal shelf (50-200 metres depth) (hectares/boat - mechanized + non-mechanized)				
Gujarat	2214	1669	1314	760
Maharashtra	852	833	680	359
Goa	7070	534	204	220
Karnataka	244	233	190	109
Kerala	123	118	92	84
Tamil Nadu	55	53	36	38
Pondicherry	–	55	51	17
Andhra Pradesh	69	53	38	25
Orissa	599	359	166	109
West Bengal	626	249	97	80
Lakshadeep	–	–	–	347
Andamans	–	–	–	3043

Source. CMFRI, 1998.

In view of the above it is critical that while the exploitable resources of inshore coastal waters upto 50 metres depth should be managed sustainably, attention ought be focussed on the offshore sector and sea farming and coastal aquaculture (bearing in mind the associated environmental effects).

Inland fisheries

With slowing down and even stagnation in yields of capture fisheries and rising overseas demand for it, new avenues of production have been sought to promote as alternative sources of supply. These have emerged primarily in the form of freshwater and brakishwater fish culture, of which, aquaculture of shrimps has become most popular.

The landing data for inland fishery sector are not firm; however, the landing

statistics at the state level show a continuous increase from 1967 touching a level of 2.38 million tonnes in 1996/97. The annual contribution of the riverine systems is put at about 25 thousand tonnes, and of reservoirs at another 40-50 thousand tonnes. The data on culture fish production from ponds and lakes are not firm.

The development of methods for coastal aquaculture and seafarming in 1970s resulted in rapid growth in production from this sector. However, the major thrust in this direction came during the Eighth Plan period (1992-97) and two Annual Plans preceding it (1990-1992). An analysis of trend in shrimp farming in India, disaggregated by states, indicates that having reached a peak at around 82.5 thousand tonnes in 1994/95, the total production of shrimp from the farming sector declined due to bans on coastal aquaculture driven by environmental considerations. The growth rate of output also depicted a downtrend. Despite rapid strides in shrimp farming, in 1996/97 India had exploited a little over 11% (135 thousand hectares) of the estimated potential area (at 1190 thousand hectares), which lies mainly in the states of West Bengal and Gujarat.

Table 2. 5 Trend in brakishwater shrimp farming in India **(metric tonnes)**

States	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	Rate of growth (%) (1994/95 to 1996/97)
West Bengal	13800	16300	16500	25000	23445	19949	-10.7
Orissa	3800	4300	3300	4800	6000	6805	19.1
Andhra Pradesh	9700	12800	26000	34000	27140	30577	-5.2
Tamil Nadu	700	1100	2000	3000	1092	1129	-38.7
Pondicherry	..	..	..	..	10	27	
Kerala	9500	9750	11500	12000	9000	8225	-17.2
Karnataka	1100	1150	1500	2500	2050	2300	-4.1
Goa	300	350	400	450	550	580	13.5
Maharashtra	930	1050	300	400	740	523	14.3
Gujarat	170	200	500	700	546	572	-9.6
Total	40000	47000	62000	82850	70573	70687	-7.6

Source. MPEDA, 1997,

Export performance

The marine sector in India is a predominantly export-oriented industry, with earnings accounting for nearly 4% of total export earnings. Consequent to the above growth in output, India exports nearly 55 varieties of marine products: primarily to Japan (over 40% of its marine exports), countries of South East Asia, Europe, USA and the Middle East. The total quantity of marine product exports increased from a meager 0.016 million tonnes in 1961/62 to 0.076 million tonnes in 1980/81 and then to 0.378 million tonnes in 1996/97. From a

small base of Rs 39.2 millions, the growth in value terms was Rs 2342.9 million to Rs 41213.6 million (US$ 1153 million) in the respective years. Evidently, in terms of year to year growth, the exports of marine products have had a checkered past, both in respect of quantity and unit values, even depicting negative growth trends in some years. These have been ascribed to a diverse set of factors such as poor fish landing, shortfall in farm shrimp output (due to diseases), exchange rate fluctuations, diversification of demands to other exporting countries and more recently environmental regulations. For instance, an absolute decline in quantity and value of exports experienced during the year 1995/96 was primarily on account of (1) sluggish market conditions in Japan due to exchange rate changes and thereafter, the effects of the Kobe earthquake, (2) embargoes relating to non-use of Turtle Excluding Devices (TED) for shrimp harvests, (3) restrictions by French, Italian (including detention of seafood at the Italian port) and Spanish authorities, (4) restrictions and embargoes imposed by the USA's Food and Drug Administration (FDA).

In comparison with its competitors, India's export earnings of marine products were lower: in 1996/97 Taiwan's exports valued US$ 1400 million, Indonesia's US$ 1600 million, China's were US$ 2300 million and Thai exports amounted to as high as US$ 4300 million.

Table 2.6 Growth of marine exports in India

Year	Quantity (Tonnes)	Value (Rs Million)	Average	Growth over previous period (per cent)	
				Quantity	Unit value
1965/66	15295	70.6	4.62		
1970/71	35883	350.7	9.77	18.6	16.1
1975/76	54463	1245.3	22.86	8.7	18.5
1980/81	75591	2348.4	31.07	6.8	6.3
1985/86	83651	3980.0	47.58	2.0	8.9
1990/91	139419	8933.7	64.08	10.7	6.1
1991/92	171820	13738.5	80.08	23.2	24.9
1992/93	209025	17685.6	84.61	21.6	5.6
1993/94	243960	25036.2	102.62	16.7	21.2
1994/95	307337	35752.7	116.23	25.9	13.2
1995/96	296277	3501.11	118.17	-3.6	1.7
1996/97	378199	41213.6	108.97	27.6	-7.8

Source. MPEDA, 1997.

Although Japan has historically been the single largest market, the countries of South East Asia and Middle East have gradually emerged as the second important market in the past decade. As a result of liberalization of import policies in the South East Asian countries, their imports of fish and fish products recorded the highest growth rates in volume, even though the value of exports had shown a relatively moderate growth. Thailand, Korea, China, Taiwan etc.

have now started importing from India, in addition to the traditional markets, namely Hong Kong, Singapore and Malaysia. Moreover, India has also started exporting marine products to Mauritius, Reunion Islands and South Africa. On the other hand, it is observed that the shares of exports to Japan, USA and EC have shown a regular decline (see Table 2.7 for trends). Whether this trend is indicative of greater diversification of export markets for Indian marine products attracted by better returns or a result of somewhat more stringent regulation in the traditional markets is, a priori, appealing to analyze. It is commonly alleged by industry sources that while some of the traditional markets have been selective in buying marine products, the South East economies have emerged as an alternative market for fish, squids, cuttle fish etc.

Table 2.7 Changing pattern of markets for Indian marine exports **(per cent)**

Year	Japan	USA	EU	Others*
1981/82	70.93	12.23	9.63	7.21
1982/83	72.68	11.78	7.57	7.97
1983/84	64.40	13.35	10.09	12.16
1984/85	67.75	14.71	9.03	8.51
1985/86	69.78	11.57	10.84	7.81
1986/87	67.42	12.22	12.90	7.46
1987/88	61.40	14.15	15.86	8.59
1988/89	59.69	11.73	20.82	7.76
1989/90	54.44	12.33	24.46	8.77
1990/91	51.30	12.23	25.96	10.51
1991/92	46.04	11.24	28.77	13.95
1992/93	45.34	10.78	28.92	14.96
1993/94	47.36	12.23	25.77	14.64
1994/95	45.98	13.71	20.31	20
1995/96	45.03	10.46	26.05	18.46
1996/97	45.76	10.58	19.17	24.49

* includes South East Asia, Middle East and Others.

Source. Manne Products Export Review, several issues.

Shrimps

Amongst the import of marine products by Japan, shrimps are very important. The Japanese import market of shrimps since the early 1970's has been characterised with steady increase in demand in the long-term which was limited by price factors in the short-run due to keen competition among major supplier countries. The apparent consumption of shrimps rose from some 178,000 tonnes in 1977 to 217,000 tonnes in 1981, while the domestic catches increased marginally from 54,000 tonnes to 55,000 tonnes over the same period. This

excess demand over supply conditions led to an increase in imports from 127,000 tonnes in 1977 to 165,000 tonnes between 1977 and 1981,which constituted the largest market of shrimp imports in the world. Within this import of shrimps, frozen shrimps account for the bulk.

India continues to be the largest exporter of shrimps since the early 1970's and it's share expanded steadily. However, with the competition among suppliers of the commodity to Japan, major exporters (except Indonesia) such as China, Australia, Thailand and Taiwan (together comprising over 25% of Japan's import market of frozen shrimps in 1981) increased their shares between 1977 and 1981. This resulted in prices fluctuation in the Japanese shrimp market. For example, between January-July 1983 it was observed that some sellers were selling even below cost-price in order to stimulate demand.

To increase India's export of frozen shrimps to Japan, therefore, supply factor became the key issue, particularly after 1980's. Thus, the increase in availability for exports of frozen shrimps was enabled by improvement of processing and packaging facilities for exports. These policies directed towards shrimp exports paid rich dividends between 1974 and 1985. Some of the important measures that were undertaken were the establishment of the Marine Products Export Development Authority in 1973 and encouragement of aquaculture against expected fall of natural production of shrimps. Other measures taken included the promotion of charters/joint ventures for development of seafishing. MPEDA undertook a project for extending technical assistance to farmers for commercial scale brackish water shrimp farming. It also set up several programmes such as Prawn Farming Training Complex in Cochin (intended mainly for imparting training to State Government fishery officials who in turn were expected to develop the programmes in their respective States). The Indian Govt also has provided cash assistance and import replenishment licenses as incentives to fishery exports. In addition, a new scheme for promoting export oriented units to boost marine exports was cleared in 1984. Under this scheme MPEDA were to participate in the equity capital of such ventures upto 26% in the case of indigenous enterprises and upto 11% in case of foreign collaborations. The ventures would include diversification of seafood exports and promotion of exports in value added forms. In the meantime, efforts were also undertaken to develop alternative markets for marine exports from India.

In the last few years, Japan's Marine Products Manufactures Association assisted by Japans External Trade Organisation (JETRO), have sent missions to explore the possibility of exports of various fishery items from India. MPEDA, as a response to this enquiry, started the investigation on the underwater resources which would be of commercial value to the Japanese market. Besides deposits of resources that ensures the long run State supply, and the level of technology to

undertake the primary processing (according to Japanese specifications) in India, the Japanese are very much concerned with the hygiene maintained in packing of the products exported by India to Japan. In 1985, these were found to be contaminated by cholera germs by a port quarantine authority in Japan. Since the degree of hygiene of marine products affects considerably their commercial value, the system for pre-shipment inspection of these products needs to be improved as one of the export promotion measures.

The above facts and figures pertaining to the Indian marine industry form the basis for several issues which are discussed and implications drawn in the subsequent sections of the chapter.

Environmental concerns in the marine industry

The environmental concerns emerging in marine sector are somewhat different from those which arise in the conventional manufacturing sectors. Being almost entirely natural resource based, fish production has greater implications for resource depletion than the predominantly local environmental effects of effluent discharge associated with manufacturing industry. Also, health consideration form a significant part of these environmental regulations. The major environmental concerns caused by fishery production, both capture and culture fisheries, are discussed below. The information presented in the subsections below is drawn from various issues of the Seafood Export Journal.

Resource depletion

Although marine resources are regenerative in nature, harvesting at rates exceeding the regenerative capacity (primarily driven by larger short run gains from lucrative export markets) can cause a secular decline in the resource potential.

Consequently, this has emerged as a major cause of clash of interest between fishing communities using traditional methods and those using new and mechanized methods of capture.

Wasteful fishing

A significant fraction of fish catch is wasted due to capture of non-consumable species of fish (which are thrown overboard) or lack of adequate downstream facilities such as storage and processing.

For instance, it is widely recognized that deep-sea fishing by mechanized fishing trawlers which indulge in great deal of selective fishing results in significant wastage of unwanted marine catch, sometimes even as high as 30-35% of the total catch.

Problems associated with aquaculture

While marine aquaculture does provides a fillip to both the quantity and quality of selected fish products such as shrimps there are significant environmental effects which cannot be ignored if mariculture and sea farming capacities have to expand to meet the growing demand for exports.

Owing to attractive short run gains from shrimp farming, in the maritime areas paddy fields have been converted into shrimp farms by impounding sea water. Not only does this displace paddy cultivation but, over a short period of time, threatens the adjoining cultivated area due to intrusion of saline water into the soil. Coastal aquaculture is a serious threat to the mangrove forests in the coastal belt, which comprise rich biodiversity reserves.

Moreover, sea farming requires around 10% fresh water (on an average) to reduce salinity to optimum levels or a process of regular water exchange. Apart from placing a demand on fresh water supplies, the impounding of sea water is a severe threat to subsoil resources as it percolates into sweet aquifers and turns them into brackish waters.

Aquaculture farming typically entails high use of manure and fertilizers to achieve higher productivity levels. The excess of these ingredients flows into nearby water bodies resulting in eutrophication*. Moreover, use of fishfeed, anabolic steroids, antibiotics and other chemicals in aquaculture farms pose a threat to agriculture in general.

Wastes from fish processing units

Fish processing plants are typically located in the vicinity of the marine ecosystem. These generate large quantities of effluents with high organic loads which, when discharged untreated into the sea or estuary, deplete the dissolved oxygen level and pose a threat to the ecosystem.

Quality regulations

Importing countries are progressively moving to stricter health and sanitation requirements for imports of food products; although similar norms are known to apply to their domestic production of food products. Exporting countries, especially those that are developing, often find it difficult to comply with these quality standards. A survey conducted by the ITC for India, Bangladesh, Indonesia and Pakistan found that for the small and medium export oriented units, distribution channels are the most bearing constraint followed by tariff and non-tariff barriers. One out of every four companies faces the tariff and non-

* Eutrophication involves deregulation of ecological processes in water and soil due to excessive supply of plant nutrients in the form of phosphates and nitrogen compounds. This leads to proliferation of undesirably large quantities of algae in ponds and lakes, which causes shortage of oxygen and predominance of bream in water.

tariff barriers and seafood exporting countries are no exception to this.

Process related regulations

In the marine sector, the first noteworthy instance of imposition of process related standards by the importing country took the form of USA putting an embargo in 1992 on the import of Mexican tuna on grounds that fish had been caught in purse seine nets which killed dolphins cruelly and in greater numbers than the US law permitted.

A similar embargo was placed yet again by the US Federal Court in 1996 on imports of shrimp from countries which caught them without the use of turtle excluding devise (TED) on the ground that it was a measure to conserve the depleting stock of marine turtles. India, Pakistan, Thailand and Malaysia were amongst the countries affected by the ban and appealed to the World Trade Organization (WTO).

In either of the above cases the exporting countries won the case at the GATT/WTO on the grounds that the importing country cannot unilaterally impose production process related standards on the exporter, which in these events applied to the method of harvesting tuna/shrimps.

From the discussions presented it is evident that there has been a substantial growth of the Indian marine sector, primarily driven by potential for exports. An associated development has been the rise in the environmental impacts of these activities and a general emergence of public awareness about these. Below, we provide some details on each of the above environmental concerns which have implications for the marine industry in India.

Environmental issues specific to Indian marine sector

The Indian marine sector, in recent years, has started being afflicted with a number of environmental (including health related) issues. Being an important SME (that too a vital foreign exchange earner), as argued above, it is equally important to analyze the effects of such issues on its export performance. Equally important is the need to analyze the effect of its export performance and drive on the domestic as well as international environment and health concerns.

To analyze these effects, it is convenient to bifurcate the environmental effects into those which emerge as external compulsions, and those caused by domestic environmental concerns. As in this study we are concentrating on the bilateral Indo-Japanese trade in marine products (India being the 7th largest producer in the world of marine products, as well as being the principal exporter of these commodities to Japan - imports to Japan exceeding over 40% of its overall exports of the same commodity), following this methodology would explicitly enable us to address our query regarding the competitiveness of Indian

SMEs with respect to environmental (and health) related policies.

External environmental regulations

TED (Turtle Excluding Device)

The Indian seafood export industry is not merely encountering domestic environmental regulations but also faced with stringent external environment regulations (that is, those imposed by the importing country) which constitute important NTBs (non-tariff barriers).

Recently, the Federal Court of USA promulgated an order which, from May 1996, banned import of seafood from countries into USA which were not using the TED. This posed a threat to exports from India as much as it did to the other major shrimp exporting countries. It was claimed that the principal reason for imposing the ban was to protect and conserve the declining stock of marine turtles. The matter, when taken to the WTO, ruled in favor of India since it was clearly a process-related standard which, according to GATT/WTO guidelines, could not be imposed unilaterally by an importing country as it goes against the principles of free trade.

India's specific stance on the issue was based on the fact that all the concerned species of turtles have been placed under the Schedule 1 of the Indian Wildlife (Protection) Act 1972, in pursuit of which, various turtle conservation programs have been devised along the peninsular coast concentrating more on the maritime zones of Tamil Nadu, Orissa and Gujarat (which are the major turtle breeding grounds). In 1990, the Government again reiterated the need for greater thrust on turtle conservation program. The Central Marine Fisheries Research Institute (CMFRI) and the Fisheries Departments of all the maritime states are continuously involved in various conservation activities throughout the peninsular coast.

Moreover, experts allege that turtles are threatened at three potential stages - (1) egg stage on the coast, (2) new hatchlings with feeble power of movement, (3) full grown turtles on their way to the coast and back to the sea. It is believed that the degree of severity of threat and its dimension and the rate of depletion due to the above are much higher as compared to accidental catch by shrimp trawlers. This is true not merely true along the Indian coast but the world over. Therefore, if turtle conservation was the sole intent, the regulating country ought to have focussed on potential depletion on account of the above factors rather than putting a process related embargo such as TED. Fishery experts hold that the US interests in turtle conservation are triggered by concerns of its industry which is seeking an export market for TEDs.

To assess the necessity of TEDs for Indian deep-sea trawlers, Vijaykumar (1996), had conducted a preliminary random sample survey of around 20

trawlers at Vishakhapatnam Fisheries Harbour in the state of Andhra Pradesh and found a rather weak basis for the US embargo. He found that on an average a trawler encounters a turtle only 2-10 times, the by-catch turtles are almost always returned to the sea, the crew are aware of the ruling that turtle catching is prohibited by law. These observations are reinforced by the fact that Indian sea fishing ventures comprise around 30,000 mechanized boats, of which trawlers constitute about 20%. Of this fraction, very few trawlers operate in the turtle-rich coastal zones of Tamil Nadu, Gujarat and Orissa. Hence, the frequency of turtle encounter and death/catch through these vessels is meager as compared to depletion due to the factors listed above. Moreover, fishermen claim that use TEDs leads to a loss of fish catch of around 15-20%.

While there was some hue and cry raised by some interest groups, on the whole industry experts feel that exports to USA account for around 10% of the total value of marine exports. These consist of shrimps caught with (1) mechanized trawlers, (2) non-mechanized trawlers, and (3) acquaculture farms. The objection by US is with regard to category (1) alone and may result in losing this share of exports. What the exporters are wary about is if USA is able to mobilize efforts from other nations which are major/growing importers from India.

Regulations for quality of food product

In anticipation of stringent quality control measures of foreign buyers the Indian government had enacted the Export (Quality Control and Inspection) Act as early as 1963 which led to the setting up of the Export Inspection Councils and Export Inspection Agencies (EIA). With seafood exports being a principal earner of foreign exchange in 1977, the government introduced an In-Plant Quality Control (IPQC) scheme under which fishery products were also included. The IPQC concept was deemed to be at par with the Quality Management Program (QMP) followed in Canada. Under this scheme only plants approved by the EIA were allowed to operate. Evidently, the exporters readily accepted the scheme and made in-plant adjustments to comply with the EIA norms. Later, a Modified In-Plant Quality Control (MIPQC) scheme, commonly known as the Self-Inspection Scheme, was introduced. Under this scheme, the primary responsibility and surveillance of quality vested with processors themselves. The exporters expressed their willingness to get enlisted with the MIPQC as it was intended to instill a degree of confidence in the foreign buyer. Nonetheless, to qualify for it the processors of fish products had to incur heavy additional expenditure on infrastructure facilities, equipment etc. With a majority of exporters belonging to the small and medium scale sector, getting subscription to the Self-Inspection Scheme and meeting the stringent norms imposed has inflicted hardships on

small units time and again. On the premise that maintaining quality was in the interest of the exporters themselves, they were later (in 1991) exempted from EIA certification and were made directly answerable to the buyer.

Codex Alimentarius Commission is the principal international body developing food safety and commodity standards based on scientific principals. More than 154 countries of the world have adopted the Codex standards and hygienic and technological code of practice for framing their health related regulations for domestic and imported products. Several of the top seafood importing countries have formulated health, sanitary and product safety regulations and laws of their own with the view to protect people from being subject to health hazards caused by contaminated food. Although linked to the Codex Alimentarius, often enough the standards laid down by specific nations are not consistent with it and vary across nations, making compliance complicated and difficult.

Japan has laid down standards and specifications for manufacturing, processing, preparation and preservation of food products through the Food and Sanitation Law (FSL) and other related laws and regulations. These include regulatory requirements for fish and fishery products. Specific requirements for FSL include marine toxins - puffer fish poison, paralytic shellfish poisoning (PSP) and diarrhoeatic shell fish poisoning (DSP), Ciguatera toxins, microbial standards and specifications for fish products, environmental toxic substances, aquaculture drugs and use of food additives. The monitoring and follow up of all the exporting countries (including India) is done by the Japanese Ministry of Health and Welfare. In general, only products in compliance with the FSL are permitted for imports. Consignments that violate the law are usually kept in bond until the importer sends them to the country of origin or destroys/disposes them or treats/re-processes them while still in bond.

The European Union (EU) with share at around half of that of Japan's (at over 40%), being an importer of nearly 25% of India's exports of marine products, is far more stringent amongst India's traditional markets for exports of marine products. Three directives bear special relevance to trade in fishery products in this respect. Directive 91/493/EEC lays down health conditions for production and placing on the market of fishery products in general, Directive 91/492/EEC lays down the health conditions for production and placing on the market of live bivalve molluscs and Directive 91/67/EEC pertains to aquaculture products. These Directives specifically deal with hygienic conditions in the process of handling, preparation, processing, packaging, storage and transportation.

Directive 91/493/EEC has recently been integrated with the HACCP (Hazard Analysis Critical Control Point) quality assurance approach. This was

implemented by the EU Directive on Hygiene for Foodstuffs (93/43/EC) which came into effect on January 1, 1996. The system is based on the recognition that microbiological hazards exist at various points in the handling and processing of fishery products, but by applying necessary preventive measures, it is possible to control them. Its main aim was to avoid systematic detention, heavy sampling and laboratory tests at the point of entry in the EU.

The guiding principle for the Directives for imports from a third country is the equivalence of Community's rules, for which an elaborate procedure has been put down. This includes verification of organizational competence of the health authority of the exporting country, a random EC inspection of the exporting establishments to cross check the reports on the functioning of the controlling authority and the infrastructure with which it operates in the concerned country.

On the basis of these directives, EU has imposed bans and restrictions several times. Mid-1997 witnessed a ban on fishery products from India, Madagascar and Bangladesh which was imposed as a result of non-compliance with quality standards; currently selective restrictions apply to China depending upon the region, company and product and for fresh fish from Kenya, Tanzania, Uganda and Mozambique.

Following the implementation of the Directives, the EC is in the process of laying down specific harmonized import conditions for the third countries exporting fishery products to the EU. So far, harmonized import conditions for fishery products have been laid down for around thirty countries, and is underway for others. The process of evolving norms is time-consuming, due to control visits to be made by the delegations from the EC. Therefore, a transition period has been agreed upon, during which the third countries are still allowed to export fishery products to the EU. The transition period, which was due to expire on July 1, 1995 was extended to July 1, 1997 and then again to July 1, 1998.

In general, establishments in the third countries have to invest heavily to achieve the EC requirements of health and sanitary conditions. Third countries often complain that the EC's method of giving approvals is not very transparent. Teams of inspectors visiting the countries processing units interpret the Community rules in a subjective manner. Even among the members of the EC, interpretation of certain rules is left to the discretion of the country concerned. For example, Italy and France apply national standards that deviate from the EC stipulations. If a consignment is found contaminated by salmonella, Italy always tries to destroy it whereas other member countries send back the consignment to the country of origin. The US Department of Health and Human Services announced in January 1994 major initiative of the Food and Drug Administration (FDA) which required that US seafood industry were to establish safety controls based on HACCP principles, with final regulations to be

announced by January 1995. In response, the HACCP regulations for fish and fishery products into the US, as well as in seafood exporting countries to USA, came into effect on December 18, 1997. After this date, seafood products destined for US markets not considered under an HACCP control plan will be considered adulterated unless it is determined that no HACCP plan was required. The HACCP regulations do not replace the existing food processing regulations but are an add-on. The compliance with HACCP needs requires financial resources and expertise, which the smaller firms in developing countries may find hard to mobilize.

In the Indian marine products industry the HACCP system for exports is posing problems due to dearth of experience in undertaking hazard analysis. Lack of epidemiological data and technical information on food processing sector are also some of the constraints with the adoption of HACCP. Major markets such as the EU, USA and Canada have implemented the HACCP for marine products industry, both domestic and in the exporting country. Other developed and developing countries alike have also commenced action on the implementation of the HACCP. This is likely to apply pressure on the Indian marine product industry, although harmonization of standards of importing countries and equality of food safety systems based on the Codex guidelines can go a long way in removing unnecessary barriers to trade.

As for the exporter's responses, it is alleged by industry sources that the seafood processing industry in India has a history of over four decades and has, at present, one of the most modern processing plants in the world using state-of-the-art processing technology capable of producing the latest seafood products. With the introduction of stringent quality standards by most of the developed countries, like the EU, USA and to a certain extent Japan, the countries processing plants did face a little problem at the outset. But steadily geared up to meet the required quality norms prescribed by the importing countries. As deadline of European hygiene requirements approached, it was these units constantly renovated and modernized the plants to conform to the EC Directive 91/493. In an article, dated November 1995 (Seafood Export Journal), it is reported that the country had over 347 processing plants with an installed capacity of over 5000 tonnes per day. The MPEDA had organized educational programs on hygienic handling of marine products covering all the aspects of quality management based on the EC Directives to improve the quality of marine products meant for exports. Thus, the Indian seafood industry had a positive response to these strictures and, in fact, is today capable of meeting the most stringent standards of the importing countries.

Domestic environmental concerns

Deepsea fishing and its impact on marine resources

Due to socio-economic and technological reasons, the fishing activities of India through the time of independence in 1947 upto the end of 1970s were primarily confined to inshore waters (upto 20 miles). This had started showing signs of over-exploitation of fishery stocks; as can be seen from data in Tables 2.1 and 2.2. The country's average annual availability of marine fish resources has been estimated to be around 3.92 million tonnes. Presently, about 2.71 million tonnes is exploited, a majority of which lies in shallower waters and has now started showing signs of over exploitation. The residual resources of about 1.21 million tonnes are found to lie in deep waters.

Deepsea fishing involved heavy capital investment, skilled manpower, established shore facilities for handling, processing and marketing of the catch, and at that juncture India did not have the requisite infrastructure in place to venture into deepsea fishing on its own. Consequent to establishment of the EEZ* in 1977, the Seventh Plan period (1980-85) strategy for marine fish development aimed at exploiting the EEZ through joint ventures with interested nations for investment in deepsea fishing.

Inviting foreign vessels to exploit deep-sea resources was considered advantageous on other grounds as well such as: providing India the opportunity to expand and develop existing harbors, making use of unused resources of the EEZ without large injection of domestic capital, offering employment avenues by giving impetus to shore-based handling, processing and marketing facilities, and raising the status of India in the global market by producing internationally demanded variety of fish from deeper waters. While in general there is consensus regarding the potential benefits of liberalizing deepsea fishing, it is frequently alleged by some industry experts that there are significant costs attached to the policy of allowing foreign participation in deepsea fishing ventures.

Foreign partners are entrepreneurs, driven by profits and having little regard for sustainable harvesting of marine resources. Owing to higher capital and other expenditures involved, coupled with lower density of catch in deeper waters, the returns obtained by these fishing trawlers were not commensurate with the efforts and costs involved.

In an effort to augment their catch, there have been frequent instances of trawlers straying into shallower water - the domain of traditional fishermen. For example, at Vishakhapatnam (in the state of Andhra Pradesh), all deepsea vessels in operation were shrimp trawlers, always fishing within 80-85 metres depth for the simple reason that all the well-known commercial species of shrimp lie in that depth range. Although some of these vessels did attempt deepsea

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* Exclusive Economic Zone.

fishing off the South-West coast for shrimps and lobsters, they returned soon to Vishakhapatnam attracted by higher profits.

Moreover, these trawlers were found to indulge in selective fishing, indiscriminately wasting large quantity of unwanted fish by throwing them overboard. A trawler is a highly destructive gear as it catches small and large fish alike. According to a report of the Fishery Survey of India (FSI), 22 pairs of trawlers and 33 stern trawlers fished in the Indian water on charter between July 1989 and December 1992. It is reported that of the total catch of 23917 tonnes, 25-30% was small juvenile fish and other varieties such as snakes, jelly fish, small crustaceans etc, which were thrown overboard. Typically, about 10-20% of the catch of these fishing vessels is wasted because it is not saleable/exportable. If a deepsea vessel catches about 10 tonnes per day, the amount of fish species/varieties crushed to death will be around 1-2 tonnes. Aggregated for about 170 licensees (both foreign and joint venture companies mainly from Japan, Taiwan, Korea and other South east Asian countries) which had been allowed to operate in India's EEZ, this amounted to a colossal waste of genetic resources. It was felt, therefore, that India must guard itself against treading on the path of other nations where intensive fishing resulted in large-scale depletion of its marine resources and resultant deprivation and dislocation of traditional fishing communities.

Further, fishery experts believe that once deepsea fishing trawlers enter shallower waters, traditionally the preserve of the artisanal fisherfolk, they deny the local consumers, especially the poor of their protein requirements and their livelihood. In one instance, the fishermen complained of two Thai vessels fishing off the Cochin coast on October 5, 1995. Incidentally, the Indian Navy and the Coast Guard have, so far, apprehended over 150 such fishing boats operating within 80 metres depth contour.

A yet another bothersome factor relates to instances when the catch did not land on the shore either because the trawlers had processing facilities on board, or due to transshipment of catch in mid-sea or even air-lifting from the vessel operating in the deep-sea to non-Indian shores. This clearly ran counter to the much touted benefits/employment opportunities to local communities and entailed loss of foreign exchange revenue to the nation at large.

It is alleged that deepsea trawling has caused havoc for the marine resources the world over. Cod, the mainstay of the British trawlers is all wiped out from its conventional grounds and the fishermen are trying out new species like the blue whiting. A large part of the British deepsea vessel fleet is now lying idle. Likewise, the Canadian Government has banned cod trawling upto the year 2000 and the ban may even continue longer.

Inviting foreign trawlers to operate in the Indian territorial waters recently

met with stiff opposition from the Indian fishermen. They complained of deepsea vessels having adversely affected their livelihood because of rapid exploitation. At home, the depletion of the resource finds support in the statistics which show that in Kerala waters the trawlers belonging to the erstwhile new India Fisheries could catch 8-10 tonnes of good sized white shrimp in around 8 days in the period 1965-70. Presently, even after spending over 15 days at sea, the fishermen would be fortunate if they got 50% of that quantity. Similarly, at Vishakhapatnam, trawlers belonging to the Chowgules used to get 4-5 tonnes of headless white and tiger shrimp in the early years of their operations in 1974-75. The situation today is such that one has to spend 21 days to get 2-3 tonnes which are medium in size. All these are symptomatic of over fishing.

The local opposition found its culmination in the seafood exporters having struck work for five days in January 1996. This had brought to halt all the activities of the industry namely, fishing, processing, transport and shipment. Amongst others, one can attribute a part of the setback felt by marine exports on account of the strike. The seafood fraternity was voicing concern over the large number of foreign trawlers indulging in indiscriminate and uncontrolled exploitation of marine wealth. These trawlers, it was claimed, enjoyed the patronage of the Government and got a subsidy on diesel purchase for their operations, while the smaller fisherfolk were denied of these benefits. They also reported considerable over exploitation of the marine resources resulting in low catch by traditional fishing community.

Concurrently the Indian government decided to put a freeze on new licenses to chartered, leased and joint-venture fishing vessels and appointed a Committee (in July 1995) to review the controversial deep-sea fishing policy. The Committee, chaired by the former secretary in the Ministry of Food Processing Mr. P Murari, was to suggest suitable steps for future deepsea fishing. During several of its sittings the Committee has found a unanimous opposition from fishermen to the entry of foreign vessels in the Indian deep-sea zone. The major recommendations of the Committee were:

- no renewal of licenses to joint venture, leased or test vessels in future;
- foreign vessels of size more than 20 metres not to be permitted to enter sea area where local fishermen in traditional crafts or small mechanized vessels ply their trade. Moreover, a distance of 50 nautical miles around the Andaman and Nicobar Islands be reserved for the Indian vessels. If the distance between islands is more than 50 nautical miles, it too should be reserved exclusively for the Indian vessels;
- fleet size for different fishing areas to be specified, based on the maximum sustainable yield and the need for conservation of resources;
- emphasis on need to upgrade technological skills and equipment used by

traditional fishermen, including mechanized boats for effective exploitation of areas reserved for them;

- need to create infrastructure for preventing wastage of fishery resources by providing cold storage, ice factories and fish processing facilities for value addition to this export oriented product;
- marine fisheries to come under the purview of one Central Ministry and the government to consider setting up of a Fishery Authority of India for formulation and implementation of comprehensive development policy of the industry;
- all deep-sea fishing regulations to be enacted by the Parliament after consultation with the fishing community.

The data indicate that the impact of a freeze on operations of deep-sea trawlers by chartered, leased or joint venture fishing vessels is unlikely to have a significant effect on India's marine product export performance. Due to a mere 10% of potential availability and negligible contribution from resources lying in the depth range of 200 metres and above (Table 2.1) and additionally, a mere 4% share of deepsea fishing vessels in aggregate production, presumably by encroaching into shallower waters, a ban on deepsea fishing is unlikely to have significant long term implications on prospects for marine output and trade. In the short run there may be minor losses incurred by processing units which were fed by deepsea catch, while over the long run a holiday on deepsea fishing and associated regulatory measures will only replenish the resource stock and will be in the interest of export performance.

Environmental effects of aquaculture

Growth of culture fisheries, having received a renewed thrust in the early 1990s, was the principal factor responsible for boosting Indian exports in the current decade. The output of shrimps accounted for a dominant fraction of fish production for export markets (around 28% in quantity and an overwhelming 65% of export earnings in 1996/97). Significant increase in shrimps farming, larger demand for Indian shrimps in Japan, Western Europe and USA along with better prices offered for Indian frozen shrimp in the major overseas markets are primary factors responsible for recent up-trend in exports, both in terms of quantity and value.

According to a report dated April 1995 (which appeared in the Seafood Export Journal), the production cost from capture method varies from Rs 67-166 per kg, depending upon the power of the vessel while the cost of production from culture practices varies from Rs 30-120, based on the type of farming technique. In comparison, the price fetched by a kilogram of *panaes monodon* at the landing site is around Rs 300. Thus, production of shrimps is one of the most lucrative

business propositions.

However, the environmental effects of this marked growth performance gradually came to fore. The sudden outbreak of disease in culture farms in 1994 (and subsequently in 1995), increasing clamor by local communities against pollution of agricultural land and salinization of underground aquifers etc. resulted in several regulations being placed on the erstwhile unbridled growth in aquaculture. The specific environmental concerns encountered in the recent past, mainly last 7-8 years, are discussed below.

Threat to paddy cultivation. The unregulated growth of aquaculture in Tamil Nadu, one of the maritime states of India caused a spate of agitation, reflected in the farmers in the Thanjavur delta having organized themselves into a movement to resist the conversion of paddy fields into prawn farms in the year 1993-94. They claimed that prawn farming not only deprived them of their precious paddy farming lands but also threatened the adjoining paddy fields by intrusion of saline water into the soil.

The State governments of Tamil Nadu as well as Andhra Pradesh, which together account for over 45% of culture shrimps production, began contemplating a legislation to regulate the prawn farming industry through a process of compulsory registration. This legislation was to be the first of its kind in India. In Tamil Nadu, the legislation aimed at ensuring that prawn farming did not pose a threat to agricultural land and sub-soil resources, ground water was not tapped to run the industry (that is, farming to be based on sea water or brakishwater), and pollution standards to be prescribed for discharge of effluents. The legislation also aimed at imposing a ban on conversion of agricultural land for prawn cultivation. The governmental notification of the ban finally came around in February 1997.

It is also claimed that, in fact, both the Central and State governmental authorities did not have accurate statistics of the number of shrimp farms in Tamil Nadu or the exact level of production from these. Though official estimates had put the area under prawn cultivation at about 1050 hectares in 1993-94, unoffficially the figures were pegged at around 2000 hectares, with annual production estimated at 5000 tonnes.

Loss of mangrove reserves. On the premise that India is endowed with abundance of both brakish and fresh water resources in different ecological zones, as also with environmentally and ecologically suitable shrimp/prawn species, during the Eighth Plan period shrimp farming was assigned a very high priority. It aimed at enhancing the area under culture farms from 70 thousand hectares to 100 thousand hectares in its terminal year, and indeed it did achieve it. However, even with coverage of over 135 thousand hectares for shrimp farming in 1996/97, it is alleged by experts that India has exploited a mere 11% of

the maximum estimated potential area of 1190 thousand hectares.

However, some industry experts are of the view that there is an inherent overestimation of this potential. It includes all coastal lands unused by man directly as potential sites for aquaculture and works out the production potential based on total area of such lands, such as from coastal swamps. However, a majority of the coastal swamps are under mangroves, which help in natural soil binding and nutrient recycling. Dense mangroves along the margins of estuaries, lagoons, and bays prevent soil erosion and silt accretion. These marginal areas which are regularly inundated by tides, contribute substantially to the productivity of the waters and form a good breeding ground for many marine and some inland species of fish and shellfish. Interestingly, in the State of West Bengal which has been identified for having the highest potential for brakishwater aquaculture is also know to harbor the largest mangrove reserves of the country (IGIDR, 1994). Thus, one ought to exercise caution in determining a realistic and sustainable prospect for seafarming and mariculture activities.

Conservation of mangroves near brakishwater farms is considered to be beneficial to aquaculture. It has been shown that one hectare of mangrove can yield 967 kgs wild fish products, which is much higher than the yields from extensive ponds which are generally in the 100-500 kg per hectare, but could be even as low as 50 kg per hectare (Macintosh, 1992 referred to in IGIDR, 1994).

However, in a number of Asian countries bordering the tropical Indo-Pacific, shrimp farming is practiced with renewed enthusiasm for earning foreign exchange by destroying precious and fragile mangrove ecosystem, thus causing permanent, irrecoverable and long term ecological disaster. In India productive mangrove ecosystems have been destroyed to develop farms and hatcheries, while mangroves are the backbone for shrimp aquaculture industry to survive. The conservation of mangroves for building shrimp farms also came under the regulation of February 1997.

Shrimp farm effluents and outbreak of diseases. The effluents from shrimp farms include unconsumed feed, faecal matter and dissolved metabolites and wastes, accompanied by residues of fertilizers and chemicals. The level of pathogens, turbidity, ammonia, biological oxygen demand and suspended solids needs to be monitored and analyzed before discharge.

Aquaculture is an extension of natural processes, with the type and quantity of inputs varying in direct proportion to the intensity of farming. Traditional methods of aquaculture are known to leave little or no impact on the environment. But intensification of culture activities deemed necessary by commercialization require increases in inputs of feed, fertilizer, chemicals etc., whose residues place a demand on the environment's assimilative capacity. Producing a kilogram of shrimp requires 100-200 cubic meter of sea water in

terms of water exchange. In addition, an intensive culture system receives around 670 kilograms of feed per hectare per day. One can comprehend the kind of damage which would be caused by such exorbitant rates of feeding. The effects could be borne by (1) coastal zones which receive the waste water, and (2) the culture system itself.

The feeds and fertilizers generate organic wastes that are ultimately washed into natural water bodies by disposal of farm water. In pursuit of higher profits, while the sanitation of the pond and optimization of other parameters is of concern to the shrimp farmer, the impact of effluents drained into the marine ecosystem is not paid much heed to. Although wastes are biodegradable, there are limits on the carrying capacity of the environment that receive the discharge.

As for the effects on the culture system, experience in countries (such as China, Thailand and even USA) which practice intensive culture fishing is full of instances of outbreak of disease in fish farms. In India, the leading shrimp farming state of Andhra Pradesh experienced a sudden spread of viral disease on shrimp farms in October 1994. It rapidly propagated to states of Tamil Nadu and Kerala. Experts are of the opinion that this was an inevitable outcome of unscientific and indiscriminate aquaculture practices, which entailed heavy dumping of feed, fertilizers, drugs and chemicals into the culture systems in pursuit of higher productivity of shrimps.

Water is a veritable repository of micro-organisms and salt, which teams up with soil having millions of micro-organisms. Input of feed is also a vector of diseases; it contains protein which is a good medium for micro-organism growth. When not consumed, all these find their way into soil, decay and release nitrogenous compounds which are toxic to shrimp. Thus poor water quality, non-optimal soil characteristics and feeding are determinants of disease outbreaks. There is ample evidence which points towards effluent rich polluted water from one shrimp farm serving as a water source for the other, thus contaminating the adjacent farms, besides paving way for rapid spread of pathogens.

In case of disease outbreak in India, all the above factors had altered the biological equilibrium and allowed the pathogens, which are dormant, to multiply faster in order to inflict epizootic (mass mortality) disease into farm water. That is, over time the aquatic system had been rendered vulnerable by wrong culture practices and mismanagement of water resources and got inflicted by pathogenic microbes. In the absence of vaccines to deal with the shrimp virus, it was almost impossible to cure the infection in the culture system. In the subsequent year of 1995 too the disease recurred in the state of Andhra Pradesh and did spread marginally to states of Tamil Nadu and Kerala. Although the intensity and scale of damage was lower this time.

Nonetheless, a wave of concern rose in the shrimp farming community due to

the setback in export of shrimps and consequent loss in export earnings due to spread of viral diseases on farms.

It is commonly held that such outbreaks are best prevented than cured. Industry experts are constantly emphasizing the need for recording and analysis of information on quality of sea water and pond water after irrigation, pre-disposal monitoring of characteristics of water quality degradation etc. Also it is felt that unwanted nutrient load should be reduced by treatment through physical (filtration and sedimentation), chemical or biological methods. For instance, use of antibiotics, anti-bacterial and anti-fungal drugs can prevent rapid development of pathogens*. The biological methods of treatment are recommended since effluents from shrimp farms are rich in nutrients, plankton and other micro organisms and suspended organic and inorganic matter. The waste water could form a good breeding ground for fin fish, molluscs and sea weeds, which will transform wastes into useful products, while reducing the pollution load on effluents. Some sea weeds are also known for effective removal of soluble nutrients such as nitrogen and phosphorus.

There are alternative points of view that claim that nearly 50% of the area under shrimp culture in India uses traditional and safe extensive farming methods. The outbreak of the disease and the public outcry against prawn culture were confined to pockets of states of Tamil Nadu and Andhra Pradesh, where farming community did not take adequate cognizance of phyto-sanitation requirements of farms and the effects on local environment. Hence, the outbreak of the viral disease.

There was a discussion in several official fora on making effluent treatment mandatory for shrimp farms, and government intervention came in the form of commissioning of a study by the National Environmental Engineering Research Institute (NEERI), Nagpur. It gave a negative report on environmental impact assessment of the 'infamous' shrimp farming in India; it was this report which gave the scientific basis for banning aquaculture activities. However, there was no general consensus on this issue; the Central Marine Fisheries Research Institute (CMFRI), an Indian Council of Agricultural Research Institute (ICAR, GoI) Laboratory, held the view that aquaculture in India had no adverse environmental impact and recommended methods of safe farming.

CMFRI noted that unregulated shrimp farming could lead to a significant increase in Total Suspended Solids (TSS), Biological Oxygen Demand (BOD) and eutrophication of creeks and estuaries due to high nutrient shedding from farm effluents. But from its survey of sample of soil, water and microscopic plankton in nine coastal areas where shrimp farming was practiced vigorously it found

* In this case one must guard oneself against resistance demonstrated by microbial species due to abuse of d which forced several countries to legally restrict their use.

basic parameter values to be well within the effluent standards of the respective State Pollution Control Boards (SPCBs).

It opined that in case of two farms the excess of BOD was due to stagnation of water in the outer canal: excess of TSS in small farms was due to already high TSS loaded estuaries. The alkalinity was high in some places but due to an already alkaline soil.

Despite the controversy the Supreme Court of India gave its final ruling in December 1996 based on the older Government notification of February 1991, ordering demolition of all shrimp farms by March 31, 1997. However, an interim stay in this regard was given thereafter. Subsequently, in February 1997, the Ministry of Environment and Forests Notification led to the creation of the Aquaculture Authority which was to exercise the following powers:

- take steps and ensure closure, demolition and removal of all the existing aquaculture activities by March 1997 from the Coastal Regulation Zone (CRZ) areas, as demarcated in the Coastal Zone Management Plans and upto 1000 metres in vicinity of Chilka and Pulicat lakes, except where traditional and improved traditional techniques were being practiced;
- no new shrimp farms to be constructed in case of the above regions;
- ensure that agricultural land, salt pan land, mangroves, wetlands, forest lands, land for village commons and that meant for public purposes is not to be used or converted for construction of shrimp culture;
- all shrimp culture outside CRZ must seek necessary approval/authorization by 30 April 1997.
- the Authority, in consultation with the NEERI, CPCB (Central Pollution Control Board) and respective SPCBs (State Pollution Control Boards) for reversing the damage caused to the ecology and environment by pollution in the coastal State and Union Territories.

Following the ban, there was a sudden setback felt by the marine culture industry. With around 70 thousand hectares under aquafarming in Andhra Pradesh (of an aggregate of 135 thousand hectares), which comprised 129 hatcheries, 35 feed mills, the 50 odd corporate companies and 250 private ventures, nearly 50% faced threat of closure following the Apex Court's judgement. It is also reported that in 1996-97 shrimp aquaculture experienced a marked slowdown in growth of output, which at 70686 tonnes was only marginally higher than the previous year, despite an increase in the total area under shrimp farms. While there was a good harvest in the first crop, the farmers could not go for the second crop on account of uncertainty. This added to the export basket a quantity of 45,940 tonnes and a value of Rs 14050 million. But for the spread of disease and the Supreme Court verdict, the target production of 100,000 tonnes and a much higher level of exports would have been achieved.

An indirect effect of aquaculture ban was on account of the uncertainty attached to government's environment policy and consequently, the fate of the shrimp farms. Therefore, banks and financial institutions were not forthcoming to provide necessary finance to producers in this sector.

In conclusion, while industry experts believe that the overall growth of the seafood industry is closely linked to the development of aquaculture it ought to bear sustainability issue in mind. Aquaculture is a sustainable activity the world over if practiced scientifically. With the Supreme Court verdict banning it in the CRZs, the industry has been faced with an uncertain future. In the absence of any laws regulating aquaculture activities, farmers in India had indulged in unscientific methods and exploited the shrimp farms for short run gains. With appropriate enforcement and monitoring of production processes, there is no reason why India cannot develop a sustainable and environmentally friendly aquaculture sector.

Wastes from seafood processing

Traditionally India has been a supplier of raw material for re-processor units in the importing countries, although recently efforts have been made to process seafood in consumer packs for exports. The Indian seafood processing industry is primarily an export oriented private sector with activities relating to (1) production of fish meal*, (2) curing/drying, (3) canning and (4) freezing; of these the freezing activity is the principal generator of pollution, mainly in the form of wastewater. There are over 372 freezing plants of which some have set up individual quick freezing (IQF) facilities to export seafood in value added form. The type of fish processed for exports are shrimps, squids, cuttle fish and fin fish.

The Central Pollution Control Board (CPCB, 1992a) survey of a sample of fish processing units found the following facts and figures. The principal water use areas are - washing of fish with chlorinated water, icemaking, cleaning of process equipment, tray and trolley cleaning, floor washing and cooling. Based on sample observations, the specific water consumption and waste water discharge from different processing units were observed to be as follows:

* Whole fish and/or waste parts which have been cooked, dried and ground.

Table 2.8 Specific water consumption and waste water discharge from fish processing units

	Specific water consumption	Waste water (cubic meter per tonne)
Frozen shrimp		
Large	1.8-7.3	1.7-6.2
Medium	1.2-17.5	1.2-15.6
Small	2.3-5.5	2.0-4.5
Cephalopods	2.3- 4.7	1.9- 4.2
Squids/cuttle fish	2.3- 6.5	2.2- 4.2
Fresh fish	1.8- 3.6	1.2-2.7

Source. CPCB, 1992a

In the seafood processing industry, a large quantity of processing/washing water (except the evaporation losses) gets discharged as waste water. The waste water characteristics of typical processing units were found to be as follows:

Table 2.9 Pollution load in waste water from fish processing units

	pH	BOD* (mg/liter)	COD (mg/litre)	TSS (mg/litre)	Oil and grease (mg/litre)
Shrimps	6.9-7.5	480 -782	1053-1600	232- 442	78-167
		(2.7- 5.3)	(5.4 - 11.5)	(1.5-2.5)	(0.5-1.0)
Cephalopod	6.9-7.2	588-708	1376-1686	265-320	60
		(4 - 4.4)	(9.6-10.3)	(1.5-2.4)	(0.4-0.55)
Fresh fish	7.3-7.4	288-576	532-1421	192-193	83-101
		(0.8 - 1.4)	(1.4-3.5)	(0.5)	(0.22-0.25)

Figures in parenthesis indicate pollution load in kg/ tonne of fish processed.

Source. CPCB, 1992a.

In the processing units there was no net addition of chemicals, thus the parameters such as Total Dissolved Solids (TDS) and percentage of sodium, sulphate and chloride etc, were not relevant. Almost all the units dispose off their untreated water into municipal sewerage system or into the backwaters. The data gathered showed that solid waste generation per tonne of finished quantity turned out to be around 49% of live body weight for shrimps and around 15-18% of live body weight for cephalopods and fresh fish.

The effluent standards evolved for seafood processing industries categorized by specific types of fish processing unit are as follows:

* The amount of oxygen (usually measured in milligram per litre) used by micro-organisms to consume biodegradable organic matter in wastewater under aerobic condition.

Table 2.10 Effluent standards for seafood processing industries

Parameters	Waste water characteristics				
	Shrimps			Cephalopods and fresh fish	
	Large (15 tonnes/day)	Medium (5 tonnes/day)	Small (2 tonnes/day)	Cephalopods (5 tonnes/day)	Fresh fish (5 tonnes/day)
Flow (cubic meter/day)	88.5	29.5	12	33	13
BOD (mg/litre)	628	628	628	648	432
COD (mg/litre)	1296	1296	1296	1531	972
TSS (mg/litre)	333	333	333	292	192
Oil and grease (mg/litre)	140	140	140	60	92

Source. CPCB, 1992a.

Wastewater from seafood processing units is biodegradable in nature. BOD, Chemical Oxygen Demand (COD), suspended solids, oil and gas and pH are the basic pollutants generated by this sector. All these pollutants are interrelated and their concentration in wastewater is dependent on the organic matter content, both soluble and suspended portions. Since BOD is a measure of easy biodegradability of the organic matter, it reflects the quality of the recipient water. It is therefore more pragmatic to control the effluent quality in terms of BOD. Considering the easy biodegradability of the wastewater from this sector, the disposal levels of other parameters will be well within the acceptance limits as long as recommended disposal limit of BOD is achieved.

The best practicable treatment scheme for the effluents consists of screening through a self cleaning screen, oil and grease removal followed by biological treatment in a sludge process system*. The estimates of costs of effluent treatment work to be small, the overall investment cost as a percentage of annual turnover is in the range of 0.65 - 2% while the annual operating and maintenance costs are around 0.16-0.48% of the same (see CPCB, 1992a for detailed calculation).

With respect to Indian exports of marine products, the qualitative analysis presented above clearly indicates that contrary to the popular belief, so far environmental regulations have not possed a loss in competitiveness nor an obstacle to the sectors export growth, despite marine products being commodities fraught with environmental (including health) considerations. When one considers this aspect with the fact that the marine sector belongs to the SMEs, the analysis of our study is all the more surprising.

It is necessary to add a caveat here, namely that it is only from the early 90s that such environmental considerations and regulations have come into play.

* Removal of organic matter from wastewater by saturating it with air and biological active sludge.

Hence, it may be too early to generalize our results as the full repercussions of the environmental policies may not have been fully played out. Also, these policies may just be the tip of the iceberg. Nonetheless, the signs emanating from our study are clearly positive. In fact, the Japanese marine market seems to be historically favourable to Indian marine exports. The more stringent regulation seems to emerged have in the EU market. But then there seems to be a steady move towards capturing new markets for the marine commodities, away from the historical and traditional markets of Japan, EU and USA.

The next interesting finding of our study is the fact that the Indian marine sector seems to have understood the importance of these environmental policies and legislations, and with the help of the Indian government have adopted these environmental considerations in the shortest possible time. Having recognized the importance of these considerations for their future existence, they seem to be keen on wanting to adopt environmentally sound techniques and methods, and in fact are keen to preempt future actions on health and environmental considerations.

Further, the study clearly brings to the forefront the importance of domestic environmental and health considerations borne largely out of public out cry against local environmental impacts, as against the perceived external norms and regulations, in the marine products sector. Almost all the rules and regulations passed by the government in this regard have arisen because of such domestic concerns. Public awareness seems to have been an important propellent here.

Finally, from the analysis undertaken it is seen that in the case of exports of marine products (a developing country SME), the causal factor for the trade-environment linkage is the effect from trade onto the environment, and not so much vice-versa (as expected). For it is the production of this commodity which results in local environmental damage and (natural) resource depletion, against which a host of domestic rules and regulations have come into play. This line of argument - as against the traditional voicing negative effects of environmental (primarily external) policies on the trade and competitiveness of a developing country , emanating from the case of an environmentally sensitive developing country SME does indicate (contrary to empirical investigations as mentioned in chapter 1) the prevalence of the 'pollution haven' hypothesis.

Regression analysis

In addition to the case study which was essentially qualitative in nature, a quantitative analysis using multivariate regression has been attempted. The objective here was to assess how different economic and demographic factors have had a bearing on bilateral trade in marine products between India and Japan.

It turns out, as is also drawn from the case studies, that while environmental regulation seems to have had a negative effect on exports, it does not appear to be a significant explanatory variable for change in export levels. We must admit that on account of lack of data for recent years, when most environmental regulations seemed to have come about, we could not attempt a more rigorous analysis with respect to environment policy as an explanatory factor for marine exports. Nonetheless, the results of the econometric exercise did yield the correct sign (direction) of the coefficient of impact on exports though, it did not turn out to be statistically significant.

Data

We have attempted a time series estimation using Ordinary Least Squares (OLS) method; the time period spans from 1970-1992 (calender years). A regression of India's exports to Japan in value terms (JMI) on the following variables was attempted:

- Gross domestic products of Japan and India (GDPJ and GDPI) and respective population levels (POPJ and POPI), both of which are determinants of competing demand for marine products. Using the series of GDP in current year prices, a series in constant 1985 US$ has been worked out for both Japan and India. It is based on implicit GDP deflators (1985=100) and foreign exchange rates for the year 1985.
- India's exports to rest of the world excluding Japan (IXROW) and Japanese imports of the marine products from rest of the world excluding from India (JMROW) are reflective of changing competitive conditions for the exporter in the world market or diversification of markets. These two were also worked out in constant 1985 US$.
- Level of domestic production of marine products in India (PRODNM) and index of domestic wholesale prices for the same (MDEX), explaining supply conditions at home.
- Environmental regulation as a dummy variable (ENVDUM), which takes value '0' from 1970-1988 and value '1' in the last four years, that is 1989-1992.
- In addition, some other variables such the rate of foreign exchange (Rs/US$ and Yen/US$) were also considered as regressors to take into account relative appreciation/depreciation of domestic currency in the world market.

Model specification

Two alternative cases were considered for analysis. These are:
Case A: Regression of JMI on variables such as GDPJ, GDPI, JMROW, IXROW, PRODNM and MDEX, but with the exclusion of the dummy variable for

environmental regulation (ENVDUM).

Case B: Regression of JMI on all of the above variables including ENVDUM.

To begin with a log-log formulation was used which, in terms of values of various statistics such as R^2, t and F-statistics failed to give significant results. Note that in case of a log-log form if we consider the dependent variable (Y) to be a function of two explanatory (X_1 and X_2), we have :

$$lnY = \alpha + \beta_1 \, lnX_1 + \beta_2 \, lnX_2$$

that is, additive separability implies that the two regressors are mutually independent. This specification gives the partial elasticity values*, represented by the respective coefficient estimates of explanatory variables, as fixed constant. For instance, with respect to variable X_1 we have the elasticity worked out as:

$$\frac{X_1}{Y} \frac{dY}{dX_1} = \beta_1$$

and similarly for the estimate of elasticity with respect to X_2 which turns out to be:

$$\frac{X_2}{Y} \frac{dY}{dX_2} = \beta_2$$

Alternatively, a translog form of the regression function estimates a non-linear function to the data set. This function has the cross products of individual explanatory variables, either all or a subset of them based on the explaining power †, appearing as regressors on the right hand side. This functional form also offers the advantage of addressing the issue of multicollinearity in a time series analysis. Specifically, a pure translog functionfor bivanate analysis has the form:

$$lnY = \alpha + \beta_1 \, lnX_1 + \beta_2 \, lnX_2 + \beta_3 \, lnX_1 \, lnX_1 + \beta_4 \, lnX_2 \, lnX_2 + \beta_5 \, lnX_1 \, lnX_2$$

A property captured by the translog formulation is that unlike the case of a log-log form, the elasticity estimates worked out are not just a scalar constant but instead a function of the size of the other explanatory variables as well, by virtue of the cross product form. For instance, in the specific functional form the

---

* which are short run elasticity estimates.

† which is the case of a semi-translog formulation.

responsiveness of Y with respect to X_1 works out to be:

$$\frac{X1}{Y}\frac{dY}{dX1} = \beta_1 + \beta_3 \, lnX_1 + \beta_5 \, lnX_2$$

which is a linear function of the level of X_1 and X_2.

In our estimation we found that use of a semi-translog specification, with cross products of a subset of explanatory variables appeared as regressors, not only provided the best fit, but also succinctly explained the relationship studied. The specific formulation used by us was as follows.

For *Case A* which did not consider the effect of environmental regulation, we had:

$$\ln(JMI) = \alpha \; \beta_1 \ln(GDPJ) \ln(JMROW) + \beta_2 \ln(JMROW) + \beta_3 \ln(GDPI) \ln(IXROW) + \beta_4 \ln(IXROW) + \beta_5 \ln(PRODNM) + \beta_6 \ln(MDEX)$$

And for *Case B* we had the results of the regression analysis are tabulated below:

$$\ln(JMI) = \alpha \; \beta_1 \ln(GDPJ) \ln(JMROW) + \beta_2 \ln(JMROW) + \beta_3 \ln(GDPI) \ln(IXROW) + \beta_4 \ln(IXROW) + \beta_5 \ln(PRODNM) + \beta_6 \ln(MDEX) + \beta_7 ENVDUM$$

Regression results

Case A (excluding ENVDUM)

Dependent variable = Ln (JMI)

R-Square = 0.854

R-Squared adjusted = 0.799

F statistic = 15.622

Durbin-Watson Statistic = 2.523

Table 2.11 Case A

Variable name	Estimated coefficient	Standard error	t-ratio (16 dof)
Ln(GDPJ)*Ln(JMROW)	0.457	0.188	2.422
Ln(JMROW)	- 6.397	2.772	-2.308
Ln(GDPI)*Ln(IXROW)	- 1.196	0.217	-5.502
Ln(IXROW)	15.224	2.752	5.532
Ln(PRODNM)	1.635	0.784	2.086
Ln(MDEX)	0.823	0.455	1.808
Constant	-3.087	3.925	-0.786

Case B (including ENVDUM)
Dependent variable = Ln(JMI)
R-Square = 0.866
R-Squared adjusted = 0.803
F statistic = 13.858
Durbin-Watson Statistic=2.617

Table 2.12 Case B

Variable name	Estimated coefficient	Standard error	t-ratio (16 dof)
Ln(GDPJ)*Ln(JMROW)	0.455	0.186	2.437
Ln(JMROW)	- 6.380	2.744	-2.326
Ln(GDPI)*Ln(IXROW)	- 1.093	0.233	-4.687
Ln(IXROW)	14.021	2.916	4.808
Ln(PRODNM)	1.7817	0.786	2.266
Ln(MDEX)	0.616	0.485	1.270
ENVDUM	-0.294	0.255	-1.154
Constant	-2.593	3.908	-0.663

As can be seen from above results, in Case A the chosen model specification gives a high coefficient of correlation R^2 of 0.799 and coefficient estimates having the right signs. For example, according to the above regression fit, India's exports to Japan are negatively related to Japanese imports from rest of the world, positively to India's exports to rest of the world (indicating a high international demand for Indian marine exports), positively to domestic output level since it is primarily an export oriented sector, and also positively to domestic wholesale prices implying that increase in domestic prices will reduce demands at home switch supplies to the international market. The value of t-statistic of all variables is greater than the tabulated value of 2.12 (at 16 dof) implying that all variables are significant explnators at 5% level of significance(LOS), with the exception of MDEX for which it is significant at 10% LOS (the tabulated value here is 1.746 at 16 dof).

While the significance of individual explanatory variables is measures by the t-statistic, the joint significance of the complete set of explanatory variables is tested by computing the F-statistic. If the computed value exceeds the tabulated value (preselected critical value), we accept the hypothesis that the model specification has the variables on the right hand side which adequately determine the dependent variable. For the present case we do get that the value of F-statistic (6,16)= 15.622>F-tabulated(6,16)= 2.74 at 5% LOS.

Similarly for Case B, the value of R^2 is higher at 0.803 and all variables other

than MDEX and ENVDUM are significant regressors (as measured by the t-statistics) and is the joint effect of all the variables (shown by the computed value of the F-statistic (13.858) > tabulated value (2.70) , again at 5% LOS . But, although the coefficient of ENVDUM has the correct sign, implying a negative effect on JMI, it does not play a significant role in determination of JMI. Inclusion of ENVDUM also tends to make the price variable, MDEX, insignificant. This supports the arguments put forward earlier for the case studies that, in the final analysis, *environmental regulation affecting the marine sector does not appear to have had a significant bearing on the level of exports of marine.*

Next, we test for any possibility of autocorrelation in the disturbance terms, a problem which creeps in due to the residuals being correlated over time. Theory talks about two possible sources of autocorrelation

- the disturbance represents the net influence of the omitted variables. If the omitted variables turn out to be serially correlated, the problem of autocorrelation in errors will arise. That is, owing to lack of data with us a crucial variable which has not been considered by us is the level of production of marine products in Japan. If this variable is correlated over time as most economic variables are, there is possibility of autocorrelation.
- another source of autocorrelation could be the misspecification of the model, that is specifying a linear function while the relationship is non-linear in nature.

The test statistic to be studied here is the D-W statistic whose value (d), which is 2.523 for Case A and 2.617 for Case B, turns out to be greater than the corresponding tabulated values of d_u at 1.821 for Case A (with 6 regressors) and 1.977 (with 7 regressors) which rejects the hypothesis of presence of serial correlation of the error terms and accepts the alternative hypothesis of absence of autocorrelation.

Therefore, the results obtained from the econometric exercise corroborate the qualitative analysis undertaken and presented above. Japan has been a traditional market for Indian marine products. This is clearly enunciated by the magnitude and the sign of estimated coefficients of the independent variables [ln(GDPJ)*ln(JMROW)] and ln(JMROW). As expected with an increase in Japanese marine imports from rest of the world, it is expected that its imports from India would decrease. But, the increase in Japanese imports from rest of the world is related to increase in its GDP, and these two together result in its imports from India being fairly inelastic.

Further, the results obtained in Case B are very similar in both magnitude as well as the sign, to the results obtained in Case A, despite Case B including dummy variables to reflect the environmental considerations in trade in marine

products. Though the coefficient of this environmental variable does show a negative sign implying that the exports of India's marine products to Japan are indeed negatively related to the environmental parameter, the magnitude of this coefficient (-0.294) is small implying that this implies inelasticity and t-value is insignificant.

Thus, it may be concluded that in the case of one of the most important SMEs in India, namely marine products, the effect of the trade-environment relationship does not show a negative fallout, contrary to general expectations.

3 Leather and leather manufactures

Overview

An analysis of the Indian marine sector, focussing on the bilateral Indo-Japanese trade, indicates that in this sector the effect of environmental policies on trade is marginal, for various reasons outlined in the previous chapter. Instead, the effect of trade (a resultant of the magnified production of the commodity in question to cater to the world demands) on environment has some bearing as can be seen by various domestic environmental concerns emanating in this sector. Nonetheless, this effect too is of little significance in terms of the effect on the exports and export competitiveness of the marine products. Can we generalize this result to typify the case for the SMEs in India? For, this would mean that the traditional arguments put forth by the classical trade theorists, that the impact of environmental policies on trade is most significant in the case of the SMEs which, due to their limited capacity to cope with the change, are the worst affected, would not hold. Or is this the result of certain factors typical to the Indian marine sector in particular.

For this purpose, in addition to the marine sector, we check whether the hypothesis holds true for the leather industry in India. Here, the focus is on trade with EU, Germany in particular, as these represent the traditional markets for Indian leather commodities (as Japan was for marine products).

Growth of the leather industry

Historical background

Leather industry in India, though amongst the first six largest foreign exchange earners, has been perceived to be the preserve of the rural traditional artisan and hence tended to be concentrated in the unorganized small scale sector. Leather manufacturing and trading were confined to the cottage industry sector for a long time and leather made goods used to meet local demands. There was no organization in existence to work for cottage-operated leather manufactures. It was in 1900s when a revolutionary change took place in identification of tanneries as a resource sector to earn foreign exchange. The export of raw hides to the West and earning of foreign exchange were the primary activities in the sector. In the late 1900s a ban was imposed on the export of raw hides and skins so as to provide an impetus to production and export of leather and leather goods. The impact of such policies was positive, leading to distinct development of this sector. Tanneries grew in number over time and produced leather in quantities matching with and sometimes even better in quality than the raw

hides exported earlier. An added impetus was provided by development of science and technology in producing leather.

Technical improvements introduced in the tanning process lay the foundations of the Madras tanning industry. The popular technology of East India (EI) tanning of hides and skins was in vogue for a fairly long time. At that time, natural products namely nuts and barks were predominantly used as a source of tannin. There were, nevertheless, basic processes preceding the tanning of hides with vegetable based tannins which continue to be in use till date*.

It was in the 1970s that a marked development in leather production technology took place. The long practiced EI tanning gave way to chrome tanning. Chrome tanned leather is also called wet blue. The versatility of chrome tanning arose mainly due to a variety of uses of leather in day to day needs in domestic and industrial sectors. The striking fact is that chrome tanning has not driven away the basic units of operation which use tannins of vegetable origin for tanning of hides and skins. Instead, it encouraged emergence of units for producing a larger range of leather chemicals of varying kinds to enable effective transfer of chrome into processed hides and skins. The change in the production technology promoted substantially the production and exports of leather and leather manufactures.

From 1970s onwards major regulation by the government was introduced in the industry with the setting up of various committees, to modernize the industry and expand it's export potential. The Seetharamaiah Committee (1973) gave recommendations to encourage the employment potential of the industry and enhance its foreign exchange earning. The major recommendations were - ban on the exports of raw hides and skins, quota restrictions on export of semi-finished leather, simultaneous increase in finished leather manufacturing capacity and comprehensive incentives for increasing finished leather exports. The Kaul Committee (1979) gave thrust to liberalized imports of capital goods. It recommended the reduction of import duty on all tanning, finishing, footwear and other leather goods machinery which were placed on the Open General License list. Thereafter, the Pande Committee (1985) adopted a three pronged approach to increase the competitiveness of Indian leather products, increase raw material availability to enable the manufacture of high quality value added leather products, upgrade skills and modernize technology, especially footwear (Mariappan in LERIG, 1997).

It has been possible for India to compete in the world market because of its large livestock population. Hides and skins are the basic raw materials derived from basically four species of animals - cattle, buffalo, goat and sheep. A look at

* The curing of hides and skins with common salt, swelling by lime, dehairing with sulphides, deliming wit ammonia salts, bating with enzymes followed by EI tanning remain the same till now. The processes in EI t demands large quantities of water to rinse the material, dissolve the leather chemicals and disperse evenly surface.

the data on livestock statistics shows that in all these categories (except for sheep) India holds the largest population in the world, accounting for between 15-50% of world population, conferring on it a comparative advantage in the production of leather goods.

Table 3.1 Livestock population in India (1000 heads)

	1994	1995	1996
Cattle	193585	194655	196003
	(14.9%)	(14.8%)	(14.8%)
Buffaloes	79070	79500	80102
	(52.5%)	(52.3%)	
Goats	118347	119242	120270
	(19.2%)	(18.6)	(17.8%)
Sheep	44809	45000	45390
	(4 2%)	(4.2%)	(4.3%)

Figures in parenthesis indicate percentage of the world livestock population.

Source. FAO, 1996.

India annually produces about 1500 million square feet of leather, mainly from buffalo hides, calf skins and goat skins. The red hair sheep skins available from South India are considered the best material for leather garments. In addition to local production, India has been importing raw material since early 1990s. During the year 1994/95, Rs 3870 million worth of raw hides/skins, semi-finished and finished leather were imported, of which finished leather accounted for nearly 55%. Imports of these products have been encouraged by making them duty free.

In India, the demand for leather products (including footwear) is quite low compared to countries such as USA, Germany, Japan, France and Italy. The annual demand for footwear is put at 1686 million pairs of which 368 million pairs are of leather footwear and 358 million of part leather footwear; in per capita terms it is around 1.8 pairs/year against 3-4 for the developed countries. The demand for leather goods mainly comprises wallets, belts, ladies hand bags etc. and in case of leather garments, nearly 95% of total production is exported. Table 3.2 shows the estimated production, domestic sales and exports in the year 1995/96.

Table 3.2 Production, domestic demand and export of leather products (1995-96)

Product	Unit	Production	Domestic demand	Exports
Footwear and components	million pairs	427.42	368.00	59.42
Leather garments	million pieces	9.34	Neg.	9.34
Leather goods	million pieces	96.64	30	66.64
Leather gloves	million pieces	69.79	Neg.	69.79
Leather manufactures	thousand tonnes	2.64	Neg.	2.64

Source. LERIG, 1998.

The above data indicate that except in case of footwear and small leather goods all the other products are predominantly manufactured for export purposes (Jagannathan & Subbarama Naidu in LERIG, 1998).

Organization of tanning industry

The tanning industry, which constitutes the backbone of the entire leather and leather product industry, is primarily export-oriented. On account of its historical origin it is concentrated only in few states; although the basic raw material (namely hides and skins) are available throughout the country. The states of Tamil Nadu, West Bengal and Uttar Pradesh together account for around 88% of the tanneries in the country. Amongst other states Andhra Pradesh, Maharashtra, Punjab and Karnataka also have sizeable amount of tanning activity.

Presently, India has around 2000 tanneries in operation, 90% of which are in the small scale sector. They specialize in a different range of leather processing - raw to semi finished or finished leather. A state-wise status of tanning industry is given below.

Tanneries in Tamil Nadu

Leather industry has a traditional base in the state of Tamil Nadu with around 895 tanneries in the State. The estimated installed capacity of the tanneries in Tamil Nadu is given in Table 3.3 below:

Table 3.3 Tanning capacity in Tamil Nadu

	Hides (million pieces per annum)	Skin (million pieces per annum)
Raw to unfinished	22	42
Raw to finished	14	52
Unfinished to finished	10	40

Source. Status paper on Tanning Industry in the country, personal communication Council for Leather Exports (CLE)

Of the 1500 million square feet of leather being processed currently in the

country, of which Tamil Nadu accounts for more than 70%.

Tanneries of West Bengal

The leather and product industries of this state are centred around the Calcutta city, namely in Tangra, Topsia and Tijalah. There are a large number of Chinese who are engaged in tanning activity in Tangra area. Calcutta produces speciality leather goods made of Shantiniketan leather made out of EI leather. West Bengal occupies the second position in terms of tanning activity in the country. There are about 540 tanneries, which lie almost entirely in the small and tiny sector. The tannery units process raw to finished leather, with most tanners exclusively engaged in processing cattle hides and goat skins. The estimated installed capacity of tanneries in Calcutta is as follows:

Table 3.4 Tanning capacity in West Bengal

	Hides (hundred thousand pieces per annum)	Skins (hundred thousand pieces per annum)
Raw to unfinished	7	70
Raw to finished	105	245
Unfinished to finished	6	25

Source. Status paper on Tanning Industry in the country

In view of the pollution problem due to Calcutta tanning industry located in the city, in 1993 the Supreme Court (Apex Judicial body of India), ordered that these tanneries shift their operations from the present location to an Integrated Leather Complex on the outskirts of the city of Calcutta. However, it is claimed by the tanners that the capital expenses for establishment of such a complex, along with the necessary effluent treatment facilities to comply with environmental norms is beyond their paying capacity. Consequently, industry experts feel that the movement of tanneries to the new location is unlikely to work out in the near future.

Tanneries in Uttar Pradesh

The leather industry is one of the traditional industries in Uttar Pradesh. The state ranks third in terms of volume of tanning activity in the country. Kanpur is the most important tanning center in Uttar Pradesh, with around 200 tanneries in Kanpur and Unnao. The Kanpur tanneries are also predominantly in the small unorganized sector, with only a few DGTD* units. Most of these units process raw

*Directorate General of Trade and Development

to finish and some fro wet blue to finish leather. Processing of buffalo hides is predominant in Uttar Pradesh besides cattle hides, buffalo calf skins and goat skins.

The estimated installed capacity of tanneries in this state is tabulated below:

Table 3.5 Tanning capacity in Uttar Pradesh

	Hides (hundred thousand pieces per annum)	Skins (hundred thousand pieces per annum)
Raw to unfinished	4	4
Raw to finished	120	140
Unfinished to finished	15	2

Source. Status paper on Tanning Industry in the Country

Footwear industry in the city of Agra in Uttar Pradesh is also largely in the small scale sector. There are a few mechanized units employing skilled manpower and using sophisticated machinery and systems. Agra is more a centre for footwear than for leather. About 100,000 people consisting of men, women and children are engaged directly in the production of shoes, chappals shoe uppers and about 10,000 people are engaged in ancillary units like shoe lace making, marketing of shoes and in supplying raw materials involved in shoe production. The total production of shoes in Agra by small and big household units is estimated at 360 thousand pairs a day in addition to about 30,000 shoe uppers a day. Of these about 80% meet the needs of the domestic market and the remaining is meant for exports.

Tanning industry in other states

The tanning industry is claimed to have originated in the Southern state of Andhra Pradesh in Ellore by the people from Tirunelveli. Later on a cluster of tanneries came up in Vijaynagram and subsequently in Hyderabad. Andhra is a good centre for raw hides. In the state of Punjab, towns such as Kapurthala, Jallandhar and Amritsar are the main leather centres. Raw hides and skins used to come from Jammu and Kashmir for processing into wet blue and finished leather. There is a big raw hide market in Amritsar. Jalandhar is the centre for sports goods. Haryana also has a big raw hide market in Hapur from where tanners all over the country buy buff calf skins and hides. The main products of the state of Gujarat are cow skin uppers and lining leathers. Since the tanning activity is rather limited in Gujarat, a large percentage of raw hides and skins in this state move out to other states particularly to Tamil Nadu, Maharashtra, Uttar Pradesh, Rajasthan and Madhya Pradesh. There is an inflow of sheepskins particularly from Rajasthan used for mixing with the local variety. In Maharashtra the tanning activity is predominantly concentrated in the Dharavi

area. Leather garments, footwear and shoe uppers are exported from the city of Bombay. Bombay is also the biggest centre for leather chemicals, meeting more than 85% of the country's demand. In Karnataka, many tanners from Tamil Nadu have set up their tanneries where raw hides and skins are tanned. Bangalore has formed an association called Mysore State Hides and Skins Merchants and Tanners' Association to meet the needs of it's leather industry. Kerala is the biggest centre for the production of quality raw hides and skins, as it has a high slaughter rate. Raw materials from Kerala are sent to other states for processing as the tanning capacity in Kerala is rather limited.

Export performance

In view of limited domestic demand for leather and leather manufactures, a bulk of production is directed towards exports. There is a substantial global market for Indian leather products. Germany continues to be our major trading partner in leather and leather manufactures, although its share has been fluctuating marginally from 21.9% in 1991/92 to 22.5% in 1994/94 to 21% in 1996/97. (CMIE, 1998). In absolute terms, the value of exports to Germany actually increased over the period from Rs 6860 million in 1991/92 to Rs 12127.2 million in 1996/97. Over 5.5% of India's exports revenues are obtained from this sector.

India's exports of leather and leather products have registered a phenomenal growth, especially over the last two decades. The value of exports went up from a meager Rs 339.3 million in 1951/52 to Rs 57780 million in 1996/97. The following table shows the decennial growth rates over this period.

Table 3.6 Decennial growth rates of leather exports

Period	Growth rates (per cent)
1951/52 to 1961/62	6.78
1961/62 to 1971/72	181.49
1971/72 to 1981/82	336.11
1981/82 to 1991/92	614.07
1991/92 to 1996/97	82.12

Source. LERIG, 1998.

The above data indicate that the growth rate peaked in the last decade (1981/82 to 1991/92). Since then the growth rate come down drastically from 1991/92 onwards. In fact for the first time in the history of leather exports, there is a 2.5% decline in 1996/97 as compared to the previous year. This could be partly explained in terms of increasing competition in the international market from countries like China, Pakistan, Indonesia, Vietnam etc. However, some industry experts claim that this could be partly ascribed to loss of confidence of the buyers on account of irregularity of supplies and uncertainty regarding

government's environment policies. Also, there is a general feeling among exporters that the overall stagnation in the leather industry in the recent past can be explained by the fact that major importing countries like Germany, Italy and France have overstocked the leather products. Also competition from China and the East European countries could be a factor.

The composition of exports in leather sector has also changed towards value added products. Presently, the share of leather products accounts for nearly 82% and that of finished leather a mere 18%. Among different leather products exported from India , leather footwear, footwear uppers, leather goods and garments are the major items. Table 3.7 shows the changing structure of Indian leather exports, and Table 3.8 and 3.9 provides data on detailed product-wise exports shares in 1996/97.

Table 3.7 Structure of export trade (per cent)

Product	1951/52	1961/62	1971/72	1981/82	1991/92	1996/97
Raw hides and skins	24.3	24.4	0.7	0.1	Nil	Nil
Semi-tanned	74.6	65.3	84.3	12.0	0.3	"
Finished		4.7	4.2	51.0	22.6	18.4
Leather products	1.1	5.6	10.8	36.9	77.1	81.6

Source. LERIG, 1998.

Table 3.8 Product wise export share (1996/97)

Product	share (per cent)
Finished Leather	18.4
Leather footwear	21.0
Footwear components	14.4
Leather goods	19.4
Leather garments	26.8
Total	100

Source. LERIG, 1998.

Table 3.9 Export of leather and leather products during April-January 1996/97 & 1997/98 (Value in Rs million)

Category	1996/97	1997/98	% variation
Finished leather	8952.99	8780.55	-1.93
Leather footwear	9929.22	8383.06	-15.57
Footwear components	6746.65	7233.97	7.22
Leather garments	12835.80	12865.96	0.23
Leather goods	8046.67	9828.21	22.14
Saddlery and harness	723.75	832.46	15.02
Total	47235.08	47924.21	1.46

Source. DGCIS, Directorate General of Commercial Intelligence & Statistics, Calcutta.

The above composition shows that India's exports are not heavily dependent on any one product category.

The major markets for Indian leather products are shown in Table 3.10.

Table 3.10 Major importers of Indian leather manufactures

Country	Percentage share in the total	
	1991/92	1994/95
Germany	21.9	22.3
USA	14.1	17.4
Italy	9.6	11.9
UK	11.4	11.2
France	4.9	5.2
Hong Kong		3.5
Russia	12.4	3.2
Sub-Total	74.3	74.7
Other countries	25 7(including Hong Kong)	25.3

Source LERIG, 1998.

The above data indicate that in 1994/95 four countries namely, Germany, USA, Italy and UK accounted for nearly 63% in total exports. In recent years, the share of USA and Italy has been increasing gradually while that of CIS countries (formally erstwhile USSR) has declined markedly from 12.4% in 1991/92 to 3.2% in 1994/95. The gradual increase in USA's share may be on account of the joint marketing effort of the National Leather Development Programme and Council for Leather Exports.

Environmental concerns in leather manufacturing

Pollution from tanneries

Water pollution

Tanneries in India process around 500,000 tonnes of hides and skins per day, generating nearly 15 million cubic metres of waste water. In compliance with the statutory requirements they are to be treated adequately and disposed scientifically.

The characteristics of tannery waste water are complex, varying from one tannery to another. The intensity of pollution is related to the quality of raw materials and ancillary chemicals with reference to geographical location. From the volume of waste water generated and their physical and chemical characteristics, it is observed that tannery wastes are stronger than sewage and far different in constituent pollutants. For example, chromium, sulphides and total dissolved solids are typical constituents of tannery waste water. In case of availability of scope to discharge it into municipal sewers, the dilution required to balance the tannery waste water with the sewerage is of the order of 30-50 times.

In case of vegetable tanning the waste stream generated by the tanning process contains large quantities of suspended and dissolved solids, a major part of which is organic. The organic portion includes tans and nontans. The latter includes inorganic salts, organic acids, salts and sugars. Amongst the wastes from individual operations, spent tan waste is the major contributor of pollution having the highest BOD and liquor. The volume of effluent discharged is of the order of 500-1000 litres/tonne of skins processed. On the other hand, chrome tanning involves treatment of pickled pelt with basic chromium sulfate (6-8%) using 100-150% of water as the medium. After ascertaining the penetration of chromium by examining the cross section, the pH of the tanning bath is raised to 3.8-4.0.

With the current methods of tanning and the type of tanning agents used for processing, poor absorption levels of 40-70% are common during chrome tanning. Such poor exhaustion levels could lead to a discharge of chromium equivalent to nearly 16000 tonnes of tanning salts annually, with the average Indian annual requirement of tanning agent being 40,000 tonnes. Such large discharge levels lead to serious material loss and ecological problems. A pessimistic estimate of the loss of economic value due to inefficient use of chromium in tanning in India is Rs.350-400 million per annum. The environmental regulatory agencies in many countries have come out with stringent stipulations of permissible levels of chromium in waste water which are in the range of 0.3-2.0 ppm. In recent years, there has been a growing social awareness to contain chromium discharge in waste waters. Conventional treatment systems adopted for removal of chromium from waste streams

produce large quantities of chrome containing sludge, which has been listed among the hazardous wastes.

The perennial rivers, namely Ganga and Damodar in the North and Cauvary in the South are reportedly affected by tanneries in Uttar Pradesh, West Bengal and Tamil Nadu respectively. Increase in TDS and depletion of dissolved oxygen in water are the common adverse impacts.

Soil pollution

Wet salted hides and skins are the raw materials for inputs tanneries. The salt content of these hides and skins is in the range of 20-30% of hide/skin weight. In leather processing the removal of salt employed for short term preservation is the first stage. Common salt discharged in tannery waste water has subsequently emerged as a matter of serious environmental concern.

Salinization of water is the primary concern assessed in light of factors such as volume, assilimilative capacity of flora and fauna, and other beneficial uses of water which serves as tannery process water. It is particularly a matter of serious concern in regions such as Tamil Nadu, where tannery clusters largely depend on ground water. The Tamil Nadu tanneries have been incriminated time and again for their contribution to impairment of groundwater quality.

The untreated process water from tanneries has been discharged o the nearby land to contain it at one place. Over a long period of time the use of land as a disposal site for wastes has resulted in contamination of soil. The receiving soil is reported to lose its productivity.

Atmospheric pollution

Tanneries are proverbially known for producing malodour. The rehydration of salted hides and skins generally emits odors of volatile fatty and amino acids evolved in the course of biological decomposition in the presence of water. Also, the stench of hydrogen sulphide along with acids, fats, carbohydrates etc. in liming, deliming and tanning processes is predominant within the tanneries. The venting out of malodorous substances to the ambient air and subsequent transport over a distance are responsible for atmospheric pollution. Hydrogen sulphide at 20 ppm (30 mg/cubic meter) in ambient air is lethal to humans (USEPA Federal Standards).

Ammonia escaping to the atmosphere from deliming is odorous and pungent. It is equally hazardous for human beings. The maximum admissible level of ammonia in air is put at 50 mg/cubic meter.

The phenolics (monohydric, dihydric and trihydric) are emitted into air during the processing of hides on the post tanning and finishing operations. The permissible level of phenolics as phenol (C_6H_5OH) in water is 10.2 mg/litre in drinking water. The toxicity of sulphides, ammonia, phenol and chromium found

in tannery wastewater was reported by Mariappan and Rao, who recommended the need to dilute the raw material to 100-150 times with freshwater in order to prevent damage to fish. The impact of tannery effluents on micro and macrophytes was studied by the scientists of the Central Leather Research Institute (CLRI) who found that germination of seed is severely affected and the growth of plants retarded.

Solid wastes

Tanneries produce huge quantity of solid wastes. About 50% of raw material input is discharged as solid wastes. The difference between municipal solid waste and tannery solid waste lies in the former being readily disposable to get marginal benefits in the form of fertilizer and fuel while the latter can yield additional revenues for the tannery through production of value added products. For instance, trimmings, fleshings and shavings can be utilized for glue manufacturing and animal feed, hair can be used for manufacture of brushes, vegetable tan bark as fuel after drying and vegetable tan sludge as manure or soil conditioner.

Solid waste, if disposed on land is known to undergo decomposition under anaerobic environment and generates odor. It also has the tendency to leach into the subsoil or underground aquifers, hazardous chemicals ranging from chromium to phenolic compound.

Occupational hazards in tanneries

In addition to the physical damage done to the environment, there are certain occupational health hazards associated with working in tanneries. For instance, leather dust consists of organic matter and chemicals absorbed during the tanning process. Workers exposed to high concentration of dust usually suffer from chronic bronchitis and other respiratory ailments. There are also skin diseases such as dermatitis, ulcers of hands and feet, leucoderma etc which occur because of manual handling of chemicals by workers.

In acknowledgment of the problems generated by the operation of tanneries and the social awareness of such issues had led to considerable local pressure on the working of these units. The environmental implications on account of improper handling and management of waste water and solid waste was being widely reported, discussed and addressed to in general community and official fora. Hence was the need to address the pollution issue in tanneries by means of legislative instruments and incentives and technological interventions, a brief account of which follows.

Environmental issues specific to Indian leather and leather manufacturing sector

External environmental regulations

Packaging regulation

A majority of the external environmental regulations have come in from the European Union (EU), particularly Germany, which is also the most significant buyer of leather and leather products from India. Product related standards in the form of eco-labels are the new instruments for ensuring environmentally sound products. Eco-labelling was first introduced by Germany in 1978 followed by other European countries. However these labels require stringent pollution limits and are very difficult to comply with. They require high standards of environmental technology and therefore high production cost which is also liable to reduce market competitiveness. Furthermore, there is the problem of applying to each importing country separately to obtain these labels.

The European Ordinance on the Avoidance of Packaging Wastes is reckoned to be a landmark in the history of environmental law affecting waste. The Ordinance affects all types of packaging, transportation or transit packaging, outer or secondary packaging and sales or consumer packaging. The Ordinance lays down that packaging must be recyclable, with priority given to material recycling, recovery for energy generating admissible only in exceptional cases and non-recyclable packaging no longer allowed. It also stipulates that all packaging must be taken back by industry and either re-used or recycled outside the public waste system. The Ordinance requires the distributor or retailer to remove the transit or transport packaging such as paper board, outer boxes, plastic foam granules or film and other transit packaging before offering the product for sale, or else provide a receptacle so that buyers can remove this material in the store rather than take it home.

German Packaging Act of June 12,1991, states that packaging shall be manufactured from materials which do not hamper the environmental compatibility, reuse or recycling of the materials used. Waste from packaging shall be avoided by ensuring that packaging is restricted in volume and weight to the dimensions actually required to protect the contents and to market the product. The Packaging Ordinance also stipulates that the manufacturers and distributors of packaging are obliged to take back used packaging and reuse or recycle it outside the public waste disposal system.

As per a report of the Indian Institute of Packaging, it is estimated that for each leather good like garments, an exporter is required to spend an amount of approx Rs.3.88 towards the disposal of packages (sales, secondary and transport packages), in addition to the estimated cost of package about Rs.6.48. For each pair of leather footwear, the cost of package disposal is estimated to be Rs.1.68 whereas the cost of package is about Rs 9.80. However since there is scope of

reduction in packing by weight or volume, it is likely that the disposal costs be reduced.

The Indian exporters are likely to be affected by the Packaging Ordinance of Germany. However, the effect may not be perceptible due to relaxation in enforcement of Packaging Ordinance in Germany during the transition period and also because most exports from India are in bulk transport packaging. Moreover, since the Packaging Ordinance is equally applicable to all exporters to Germany, irrespective of their origin, Indian exporters are not likely to be in a dis-advantageously placed in terms of increased cost of disposal in Germany, provided the exporters economize and optimize on their packaging costs.

Product standards

Germany has general laws on products hazardous to health and to the environment:

- Certain Azo-dyes : prohibition
- PCP : 5 ppm
- Cadmium : (in plastic or paint surface) 100 ppm

In 1991, German custom officials disallowed entry of Indian leather products into their country. The reason given was that these products were highly contaminated with pentachlorophenol (PCP), a toxic fungicide. Similarly, use of formaldehyde and benzidine containing dyes and many other solvents is also restricted and use of eco-friendly chemicals has become mandatory. For formaldehyde, the limit value is 1500 mg/kg.

Moreover, there is an EU directive for the labelling of footwear. The label should contain information about three components of the footwear the upper part, the lining/innersole and the outer sole. In Germany this legislation is implemented under an amendment to the German Commodity Goods Act. Azo-dyes are often used in the coloring process of leather products. Some azo coloring agents have carcinogenic properties or may form amines, which have carcinogenic properties. The ban on azo-dyes is applicable to all products which are in contact with the skin for prolonged periods, like clothing and shoes. Leather products from which the skin contact is uncertain like purses are still under consideration.

The German Government has banned the use of the following azo dyes as of January 1, 1995: 4-amonodiphenyl, benzidine, 4-chloro-o-toluidine, 2-napthylamine, o-aminoazotoluene, 2-amino-4-nitrotoluene, p-chloraniline, 2,4-diaminoanisole, 4,4-diaminodlphenylmethane, 3,3-dichlorbenzidine, 3,3-dimenthoxybenzidine, 3,3-dimethyl-4, 4-diaminodiphenylmethane, p-Kresidine, 4,4-Methylene-bis (2-chloraniline), 4,4-oxydianiline, 4,4-thiodaniline, o-toluidine, 2,4-toluylenediamine, 2,4,5-trimethylaniline.

India, in response, has effected a ban on PCP as well as azo dyes.

However, despite the increased costs of compliance to environmental regulation, the domestic exporters do not feel that they have lost out on their international competitiveness since, in so far as the external regulations are concerned all the exporting countries alike would have felt the brunt. For instance, in the recent past China had almost 30% of it's exports rejected by buyers in the EU on quality grounds as compared to India's 4%. Hence there is no marked threat to our trading position in the international arena. Moreover, the government has been taking the initiative to help the Indian exporters to maintain their export competitiveness in the new era of stricter environmental regulations, both by means of subsidies and technical assistance. This would have, necessarily, helped the exporters to tide over whatever marginal setback they may have suffered during the transition period.

Also, in the future, cleaner production processes in developing countries may be stimulated by offering import-tariff preferences for ecologically sound products under the general system of preferences(GSP) of the European Union. The European Commission has proposed enforcing a so-called 'Enforcement Regime' in 1998 in which 20-30% additional Import-tariff preferences would be offered on ecologically friendly products and/or humanly sound products. In view of these considerations an early switch over is only in the interest of the Indian exporters.

Domestic environmental concerns

In 1972 the UNEP convention at Stockholm on Environment and Human Settlement stressed the need to enact legislation for the prevention and control of pollution by all man made activities. Water was the subject of immediate interest. As a result the Water Act, 1974 came into implementation in India. The Act was adopted by all the states and subsequently the State and the Central Pollution Control Boards came into existence. Under the Act all forms of anthropogenic activities responsible for causing environmental pollution have been covered. The operation of tanneries were also included and the tanneries were required to provide necessary facilities within the precincts for controlling water pollution. Also, adoption of cleaner technologies, recycling and reuse, waste minimization etc. within the plant and end-of-pipe treatment within the premises became essential. Despite this the implementation of the Act was ineffective due to lack of awareness among the public, want of qualified personnel to handle the legal instruments and monitor the programmes.

However, considerable attempt has been made by industries (with some governmental assistance) to comply with the rules and guidelines enunciated under the Act. For instance, the achievement of tanneries in Tamil Nadu has been noteworthy where a majority of the tanneries set up individual Effluent Treatment Plants (ETPs) and Common ETPs. The Ganga Action Plan, GAP 1984

(plan to clean up the Ganges river) enabled the tanneries in Uttar Pradesh to join hands with the local body (Jal Nigam) in the establishment of the CETP. The tanneries in Punjab, Madhya Pradesh, Orissa, Karnataka and Andhra Pradesh followed after Tamil Nadu with only the state of West Bengal yet to comply with these regulations.

Following are the details of CETP's and ETP's in Tamil Nadu:

Table 3.11 Status of CETPs and ETPs in Tamil Nadu

	Existing	Proposed	Total
Number of tanneries	895	299	1194
Connected to 7 operational CETP's	425	58	483
Connected to 10 CETP's under construction	248	94	342
Proposed to be connected to 13 CETP's under advanced stage of planning/early construction	120	147	267
Tanneries having own ETPs	72	-	72
Tanneries without pollution control devices	30	-	30

Source. Status Paper on Tanning Industry in the Country.

In case of Tamil Nadu, the Supreme Court of India had passed orders from time to time since May 1995 in response to the public litigation filed by the Vellore Citizens Welfare Forum against the pollution from tanneries. It ordered that:

- all the tanneries spread over the state of Tamil Nadu in selected clusters which were not connected with the above mentioned 7 operational CETPs be closed down and not permitted to operate till time such that the CETPs are constructed to the satisfaction of the (Tamil Nadu Pollution Control Board) TNPCB;
- of the 51 tanneries in the North Arcot district having individual ETPs, 34 were not complying with the BOD standard of TNPCB;
- the other 30 tanneries which had not been connected to any CETP and reported to have not set up the pollution control devices were also directed to be closed by the order dated April 9, 1996.

Based on the reports filed by the CPCB and TNPCB, and after the inspection of 72 tanneries in the state, the Court suspended the closure orders for 57 tanneries for a period of 10 weeks, beginning May 6, 1996. But 15 tanneries which were reported to have full-fledged effluent treatment plants and were also connected to CETPs remained closed. These tanneries appealed to the Court for suspension of closure orders as they had set up primary ETP/Pre-treatment

facilities as prescribed by the TNPCB. Thus, at that time nearly 407 tanneries remained closed in the state of Tamil Nadu.

Since most of the tanneries have been in the small scale sector, the initial impact of the legislation was to cause a lot of hardship since the cost of switching over to cleaner processes could not be borne individually by them. Therefore, the CLRI, Council for Leather Exports (CLE) and TNPCB came together to set up common facilities for effluent treatment for a cluster of tanneries in Tamil Nadu where the idea had originated initially. The proposal for installing these was mooted by the Planning Commission in 1989.

The financing pattern for these tanneries was as follows.

1. Promoter's contribution: 20% of project cost.
2. Central Government subsidy: 25% of project cost, subject to ceiling of Rs. 5 million.
3. State Government Subsidy: 25% of project cost, subject to ceiling of Rs. 5 million.
4. Loan from IDBI: 30%of project cost.

In view of the ceiling of Rs. 5 million, the tanners faced major financial problems for meeting additional investments to complete the projects as the average cost of CETP's is more than Rs.30 million.

The tanners also faced a hardship on account of delays in obtaining sanction and release of subsidies from both the Central and State Governments as well as borrowings from the financial institutions such as Industrial Development Bank of India (IDBI), State Industrial Development Bank (SIDBI), Housing and Urban Development Cooperation (HUDCO), etc. The interest cost of borrowings was also stated to be high, ranging between 16.5%-19.5% per annum. Additionally, there were procedural complications arising from the contribution from one agency dependent upon a matching contribution having been received from another, causing additional hardships.

Moreover, the CETP's as well as individual ETP's set up for treatment of tannery effluents had to meet the pollution control norms set by the TNPCB which were more stringent than the norms fixed by CPCB (based on Minimal National Standards for Tanneries). The comparison between the two is given below:

Table 3.12 TNPCB vs CPCB standards for effluents from tanneries

Parameters	CPCB Standards	TNPCB Standards
pH(Hydrogen ion concentration)	5.5-9.0	5.5-9.0
BOD for 5 days at 20° C	100 mg/litre	30 mg/litre
COD	250 mg/litre	250 mg/litre
Suspended solids	100mg/litre	100mg/litre
Sulphides (as S)	2mg/litre	2mg/litre
Total chromium	2mg/litre	2mg/litre
Oil and grease	10mg/litre	10mg/litre
TDS	..	2100mg/litre
Chlorides	..	1000mg/litre
Sulphate	..	1000mg/litre

Source. Status paper on Tanning Industry in the Country

Despite the listing of norms, in 1990/91 compliance was difficult as a majority of tanneries lacked the technical know-how of CETPs and there were not too many consultants around. Since then tanners have managed to train their workers on CETP's and undertake product and process changes to meet such norms. However many tanners also faced problems particularly in 1995/96 when the Supreme Court ordered the closure of all tanneries which were not complying with the prescribed standards.

A majority of the above problems were tackled effectively by collaborative effort of the industry, the government and the technical institutions such as the CLRI and NEERI. Firstly, in early 1997, the Ministry of Environment and Forests had relaxed the ceiling on Governmental subsidy for the installation of CETPs, which, according to the tanners was a major step in taken in the interest of helping tanners to expedite the construction activity. Next, institution of a project whereby CLRI and NEERI, worked jointly to provide the necessary technical assistance to the tanning industry on in-house process changes and end-of-the-pipe treatment facilities, aimed at helping tanners overcome the technical constraints. UNIDO in cooperation with CLRI also launched a complex programme of implementation of environmentally cleaner technologies in selected tanneries to demonstrate the potential of available cleaner technologies. The technologies chosen for implementation were - ammonia free and cleaner wet tanning, chrome recovery and reuse, mechanical desalting and sulfide reduced liming.

In the state of Uttar Pradesh, nearly 165 tanneries are connected to the CETPs at Jajmau, which has been set up and operated by the Indo-Dutch Environmental and Sanitary Engineering Project, Kanpur as a part of the Ganga Action Plan. It is designed on Upflow Anaerobic Sludge Blanket (UASB) treatment and combined with domestic sewage.

In Unnao (Uttar Pradesh), there are 21 tanneries with CETP facility at a cost of Rs 19.5 million, of which the subsidy from the State and Central Governments is to the tune of Rs 9.6 million. In Unnao, there are additional 10 tanneries with individual ETPs and no tannery is remains closed in response to the Court directives. Moreover, the treated effluent of the 165 tanneries is discharged along with domestic sewage in the ratio of 1:3 and there is no problem relating to meeting the standards.

The problem of the Calcutta tanners (in the state of West Bengal) is unique. The proposed relocation of the industry involves huge costs, estimated at Rs 1800 million, of which nearly Rs 640 million is needed for setting up the CETP alone. Since such huge investment is beyond the realm of affordability of the small tanners, financial help is being sought from SIDBI, World Bank and the State Governments. The State Government of West Bengal has decided to award the contract on Build-Operate-Transfer (BOT) basis to a private company, and the price of land was fixed at Rs 860 per square meter (including the cost of the CETP). The Court, subsequently, revised this cost down to Rs 600 per square meter. But the tanners still find the costs prohibitively high and the matter continues to be unresolved.

It is indeed the case that the costs of operation of tanneries has gone up marginally as a result of the new norms. But, the cost of this change as reflected in the export price is not exorbitant, varying in the range of a mere 1-2% of the cost of leather production (see CPCB, 1992b). Again, the situation is not the same in all the States. In Calcutta (West Bengal), for instance, the regulation has not been effective. As a result the tanneries have not had to undertake additional costs to meet such norms. Likewise, in Kanpur the costs of individual tanners has not gone up by as much because a majority have benefitted by being connected to the Ganga Action Plan. Consequently, their effluents are being treated along with the domestic waste at a very nominal charge. Thus the tanners in Tamil Nadu feel that they have lost out on their cost competitiveness vis-a-vis the Calcutta and Kanpur tanners. Finally, industry experts are of the opinion that in response to the directives of the Supreme Court in the recent past, the tanning industry has undertaken substantial measures by investing huge money to tackle the problem of pollution. While the response of the industry to adapt and change to the structure environmental regime has been positive, it is felt that the mass closure of tanneries did shake the confidence of overseas buyers having implications for our exports. Thus it is felt, needs to be overcome by highlighting and publicizing widely the work of industry and official agencies in tackling the problem.

To summarize, in response to environmental regulations which came into play in the past decade, the Indian industries have responded to the challenge by adopting new technologies for waste treatment and improving the quality of their

products to meet international as well as domestic prescribed standards. In the process they have had to incur some costs which may have reduced their competitiveness marginally. However, the interesting aspect that has came out of the analysis seemed to have is that the exporters lost out marginally to domestic competitors as compared to international competitors. Most exporters seem to have tided over the costs of readjustment fairly smoothly and in fact feel that they have benefitted from the process. Many of the tanneries which had been shut down have opened up again. Despite the bans on PCP and Azo-dyes, Indian exporters are optimistic since the ban applies equally on all countries and relative cost-competitiveness has not been affected.

This case, therefore, also echoes results similar to those obtained from the case study of the marine products sector. As in case of marines, more than the environmental regulation affecting trade patterns and export competitiveness (the case of external environmental regulations), it is the production of these commodities (primarily for export purposes) which seemed to have rise to various environmental problems, which are best voiced in the domestic environmental concerns and regulations emanating in this sector. Thus, here too, as in the Indian marine products sector, the argument that SMEs of developing countries are worst affected by the trade -environment nexus does not hold . Though the reasons being very different from those in the marine products sector.

4 Conclusions

As Jagdish Bhagwati has said, "The case for free trade and, hence, trade liberalization depends upon the degree to which markets reflect the real costs that economic activity imposes on people and the environment" (Bhagwati, J., 1988). It is not, therefore, surprising that both these issues, international trade and environment, are not only linked together, but should also reinforce and sustain each other.

For making trade and environment mutually supportive, an open multilateral trading system makes possible a more efficient allocation and use of resources and thereby contribute to an increase in production and incomes and lessening demands on the environment. It also provides additional resources needed for economic growth and development and improved environmental protection. On the other hand, trade measures should be applied for environmental purposes only when they address the root causes of environmental degradation so as not to result in unjustified restriction on trade.

Taking into account the scale on which environmental problems occur, domestic environmental policy may be taken recourse to and a country may unilaterally decide to reduce and/or abate certain amount of the domestic emissions and/or waste by setting taxes, subsidies, standards or other regulations. But, here, it is vital to be aware of how these unilateral actions would alter patterns of production, consumption, trade, and impact the country's international competitiveness.

For a developing country, of prime importance is the need to hybridize its binaries of socio-economic growth and welfare on one hand, and its environmental and energy concerns on the other. In this regard the small and medium sized enterprises of the developing country become essential. These enterprises are not only, largely, export oriented, but are also some of the largest foreign exchange earners. It is these very enterprises, in the traditional literature on trade and environment, that are expected to be adversely affected by the trade and environment linkages due. The reasons for this are many including lack of economics of scale, inadequate financial capital, and resource intensive production pattern. Hence, here the causality expected to flow from the environmental policies and considerations (primarily external) to adverse effects on the trading pattern and competitiveness in turn resulting in a negative effect on the environment.

This study attempts to analyze this very issue taking the case of the Indo-Japanese trade in marine products. Contrary to traditional expectations, the

analysis undertaken reveals some interesting results:

- There has been a spate of environmental regulations in India, having implications for a range environmentally-sensitive sectors. However, a majority of them have been of very recent origin (mainly last 4-5 years) making it difficult to discern as to whether complying with these has adversely affected the sectors' competitiveness.
- While there are indications of specific sectors facing hardships in the aftermath of the regulations, both on account of financial and technical constraints, and more so in case of the small and medium sized enterprises both in the marine and leather sectors, the setback felt by them has been more of a temporary nature. They seem to have accepted the new, environment-friendly regime and recognized its importance for their future existence. They expect the 'green' movement to catch momentum the world over and find it in their interest to include it in their day to day decisions, to gain the confidence of the importers. The afflicted sectors have responded positively by adopting environmentally sound practices and are keen to preempt future course of action internalizing the environment and health considerations.
- Despite India being a low income developing country, with several impending social and economic priorities, it is indeed heartening that a majority of the compulsions relating to environment protection having come about as an initiative of the domestic government. These have been a response to large scale public opposition to local environmental effects arising from marine and leather sectors, indicating general awareness amongst the populace of environmental concerns. This is not to say that external environmental regulations have been any less pressing than domestic regulations, but in relative terms the latter seems to have had a larger bearing on the sector's decision to change.
- The government has not merely assumed the role of mere regulator, but instead come forth and provided the necessary funding support and technical assistance (through various governmental laboratories and specially initiated programs) to help the producing sectors during the period of transition. Although, there may have been instances of procedural delays and problems of decision making in the interim, but these have also been resolved expeditiously to a large extent. This has been particularly in the interest of the small and medium scale units which were otherwise finding it difficult to cope with the change. In this respect the importing country has also been very helpful. They have considered the very point that being an SME the domestic sector would need some time to adjust. Hence on a number of occasions they have been patient with their norms. They also have come up with both technical and financial help in assisting the exporting sector to

comply with their standards. The case of JETRO and the Japanese Marine Products Manufactures Association's missions and assistance is a case in point.

- In most cases, while the cost of capital for pollution abatement has been high, the overall cost as a percentage of sales turnover has been low, often in the range of 1-2%. The problem of high up-front capital investment has been tackled by government providing/arranging for subsidies to bridge the financial gap. In addition, with intensive technical research, it has been possible to device alternative methods involving in-process changes, end-of-the-pipe treatment, recovery and recycling of basic inputs, all leading to a more efficient production process. Conservation measures such as chrome recovery, and use of by products of marine and leather processing for conversion to useful value added products has yielded double dividends in the form of reduced pollution load and a part offset for pollution abatement costs.
- In case of some form of regulations having direct implications for the volume of output, such as the TED related embargo imposed by the US or the ban on deep-sea fishing by the Indian government, the volume of output affected is rather small and therefore not had significant effects on the exports. In any case, the market for both the goods considered, marine in particular, has been rather buoyant with the result that even if there were small negative impacts on the quantity produced, the value of exports showed a steady increase.
- In case of a majority of external regulations, the exporters were of the view that the cost competitiveness of exporting units the world over would have been affected a like. So they have not lost out in relative terms. A caveat here that the set of exporters is not a homogeneous group, but each of them is in at different level of modernization. The cost of pollution abatement at the margin of the producing unit is known to be inversely related to the level of modernization.
- Inter State disparities in stringency of environmental regulations seem to be more important in affecting the competitiveness of the export sector as a whole rather than inter-country differences. Further, the confidence of the importer has been somewhat shaken due to the uncertainty surrounding the domestic country's environmental policies. There have been instances of Indian marine sector has feeling a pinch due to lack of financial support forthcoming from funding bodies and institutions.

What the study indicates is that the 'pollution haven' hypothesis needs to be re-visited. For the analysis undertaken delineates the causality in the trade-environment nexus, with respect to the SMEs, to flow from trade into environment and back into trade. As what this implies is that developing

countries may tend to specialize in more polluting, resource intensive industries with increasing environmental awareness worldwide due to technical or resource endowments characteristics. This is an area of research which is important and needs detailed consideration.

Finally, this study also attempted to learn from the Japanese environmental model and if possible then identify future areas of cooperation. On this single point the study is silent as in both the largest and the most environmentally sensitive Indian SMEs analyzed, not only external environmental policies and legislations take a backseat to domestic environmental concerns, but the very nature of these SMEs preclude a counterpart Japanese (or for that matter German) example. This aspect could have been better explored if instead of the SMEs some other organized sector industry had been analyzed. Nevertheless, what is required is to study the essence, implementation and effects of Japan's Basic Environment Law Bill along with its Basic Environment Plan and try and emulate this umbrella framework within Indian contexts.

Data on bilateral Indo-Japanese trade in marine products

Constant	POPJ	GDPJ	GDPCJ	JMI	JMROW	ROWXROW	POPI	GDPI	GDPCI	IX	IXROW	PRODNM	MDEX	DEFJ	DEFI	Rs/$	Yen/$	Yen/Rs
(1985=100)	(mln)	(mln dlrs, Const)	(dlrs, Const)	(mln dlrs, Const)	(mln dlrs, Const.)	(mln dlrs, Curr.)	(mln)	(mln dlrs, Const)	(dlrs, Const.)	(mln dlrs, Const.)	(mln dlrs, Const.)	(million tonne)	(85=100)	(85=100)	(85=100)	(Curr)	(Curr)	(Curr)
1970	104 3	998034 3	9566 0	53.9	3358 7	2618 1	547 6	148791 6	271.7	180 3	126·4	1 6	19 6	43 5	28 8	7 5	350 5	46 7
1971	105 7	1050843 8	9938 2	99 2	4139 8	3001 0	559 2	138290 5	247 3	188 4	89 2	1 8	20 6	45 5	30 3	7 6	349 3	46 0
1972	107 2	1148179.8	10714 1	119 8	4237.1	3619 0	571 0	150273 1	263 2	249 5	129 7	1 9	23 1	47.6	33.7	8.3	271 6	32 8
1973	109 0	1241238 4	11387 5	173 0	4699 5	4968 3	593 0	155578 9	262 4	294 8	121 8	1 6	26 8	53 7	39 5	8.1	291 0	35.9
1974	110 0	1231050 7	11191 4	122 6	3068 3	5423 5	607 0	157491 3	259 5	237 5	114 9	2 0	31 9	64 6	46 1	8 4	296 7	35 5
1975	112 0	1264492 0	11290 1	224.3	3269 0	5848 2	621 0	171968 5	276 9	329 6	105 3	2 3	31 6	69 4	45 4	9 0	296 7	33.1
1976	113 0	1317850 8	11662 4	333 4	4219 7	6986 2	634 0	174950 0	275 9	516 3	182 9	2 3	34 6	74.8	48 1	8 7	270 3	30 9
1977	114 0	1377133 6	12080 1	280 2	4027 7	8547 7	647 0	187555 3	289 9	463 4	183 1	2 2	38 5	79 8	50 8	8 2	210 8	25 7
1978	115 0	1444059 7	12557 0	243 0	5294 8	16758 9	661 0	198368 8	300 1	364 2	121 2	2 3	57 8	83 8	52 1	8.1	219.1	26.9
1979	116 0	1524990 2	13146.5	349.7	5822 4	13127 8	675 0	187920 5	278 4	512 6	162.9	2 3	50 7	86.0	60 4	7 9	227 7	28.9
1980	117 0	1578849 3	13494.4	283 2	3241 8	14074 6	689.0	200413 3	290 9	406.4	123 2	2 4	53 4	90 1	67 3	8 7	219 6	25 4
1981	118.0	1635509 8	13860.3	292 2	4250 2	14644 8	703 0	213485 2	303 7	410 1	117 9	2 4	69 4	93.4	74 3	9 4	248 2	26.3
1982	118 0	1687307.4	14299 2	287.8	4728 4	14368 9	718.0	221593 6	308 6	402 7	114 9	2.4	84 3	94 9	79 8	10 1	237 4	23.5
1983	119 0	1731684.3	14552 0	264.2	4987.1	14779 8	732 0	237974 1	325 1	396 3	132 1	2 5	90 7	96 3	86 5	11 4	237 3	20 9
1984	120.0	1806230 4	15051.9	298.8	5403.3	15004.8	747.0	246839.6	330 4	436 7	137 9	2.8	87 6	98 5	93 0	12 3	238 1	19 4
1985	121 0	1896866 6	15676.6	253 6	4490 7	16057 2	763 0	260168 7	341 0	372 7	119 1	2 9	100 0	100 0	100 0	10.1	168.9	16.8
1986	121 0	1949772.3	16113.8	290.4	6038 8	21652 1	779 0	272745 8	350 1	429 4	139.0	2.9	106 9	101 9	106 5	13 0	143 9	11 1
1987	122 0	2034121 7	16673 1	291 4	6355 0	26649 7	795.0	285690.6	359 4	437 8	146 4	3 0	110 9	101 8	115 7	13 9	128 1	9 2

Constant	POPJ	GDPJ	GDPCJ	JMI	JMROW	ROWXROW	POPI	GDPI	GDPCI	IX	IXROW	PRODNM	MDEX	DEFJ	DEFI	Rs/$	Yen/$	Yen/F
(1985=100)	(mln)	(mln dlrs, Const)	(dlrs, Const)	(mln dlrs, Const)	(mln dlrs, Const)	(mln dlrs, Curr)	(mln)	(mln dlrs, Const)	(dlrs, Const)	(mln dlrs, Const.)	(mln dlrs, Const.)	(million tonne)	(85=100)	(85=100)	(85=100)	(Curr)	(Curr)	(Curr
1988	122 0	2168435 9	17774 1	292 2	8382 2	30409.7	811.0	314132 9	387 3	496 0	203 8	3 2	116 7	102 1	125 0	16 2	138.2	8
1989	123 0	2278227 8	18522 2	261 7	7985 7	30880 1	828 0	334840 1	404 4	470 7	209 0	3 7	129 7	103 9	135 3	17 5	143 8	8
1990	124 0	2397443 3	19334 2	304 2	7470 8	34648 7	845 0	352222 3	416 8	562.9	258 7	3,8	144 2	106 2	150 2	22 6	134 4	5
1991	124 0	2506924 9	20217 1	377 8	8178 1	37196 8	862.0	354861 4	411 7	788 4	410 6	4 2	160 3	108 2	172 1	25 9	126 6	4
1992	124 0	2534088 0	20436 2	391 0	7646 6	39278 2	880.0	371064 9	421 7	880 1	489 0	4 4	178 3	110 0	188 6	30.5	110.0	3

Source Compiled from. Chandok H L and The Policy Group, 1990; CMIE, 1997 & 98, FAO, 1996; GoI, 1996 & 97; IMF, ***International Financial Statistics***, MPEDA, 1997; MPEDA, *Marine Products Export Review*, RBI, 1997; Seafood Exporters Association of India, ***Seafood Export Journal***; UN, ***International Trade Statistics Yearbook***, UN, ***Commodity Trade Statistics***; UNCTAD, ***UNCTAD Commodity Yearbook***; UNCTAD, ***Handbook of International Trade & Development Statistics***, World Bank, ***World Tables.***

Note:

1 POPJ Population of Japan
2. GDPJ Gross Domestic Product of Japan.
3 GDPCJ. Per Capita Gross Domestic Product of Japan.
4. JMI. Japanese Marine Imports from India.
5. JMROW Japanese Marine Imports from Rest of World (Excluding India).
6. ROWXROW Rest of the World Exports of Marine to Rest of the World (I.e., Excluding India and Japan)
7. POPI· Population of India.
8 GDPI Gross Domestic Product of India.
9. GDPCI· Per Capita Gross Domestic Product of India.
10. IX· Indian Exports of Marine.
11. IXROW Indian Exports of Marine to Rest of the World (Excluding Japan).
12. PRODNM: The Indian Marine Production (Quantitative).
13. MDEX: The Wholesale Price Index of Marine Commodities (India).
14. DEFJ The Gross Domestic Product Deflator for Japan.
15. DEFI: The Gross Domestic Product Deflator for India.
16. Rs/$: The Nominal (Current) Exchange Rate for India vis-à-vis US Dollar.
17. Yen/$ The Nominal (Current) Exchange Rate for Japan vis-à-vis US Dollar.
18 Yen/Rs: The Nominal (Current) Exchange Rate for Japan vis-à-vis Indian Rupee
19 Mln Million.
20 Dlrs/$ US Dollar
21 Curr: In Current Prices.
22 Const · In Constant Prices
23. 1985=100· The Base Year is 1985 (for Constant Prices).

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